A SCIENTIFIC AND POLICY REVIEW OF THE PROTOTYPE OIL SHALE LEASING PROGRAM FINAL ENVIRONMENTAL IMPACT STATEMENT OF THE U. S. DEPARTMENT OF THE INTERIOR

Prepared by the
Environmental Impact Assessment Project
of
The Institute of Ecology

A Scientific and Policy Review of the Final Environmental Impact Statement for the Prototype Oil Shale Leasing Program of the Department of the Interior

Submitted to the Department by the
Environmental Impact Assessment Project
of The Institute of Ecology

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October 29, 1973

The Honorable C. B. Rogers Morton
Secretary, The Department of
the Interior
Washington, D. C. 20240

Dear Secretary Morton:

Pursuant to notice given in our letter to you of October 3, 1973, we hereby submit our analysis of the Final Environmental Impact Statement for the Prototype Oil Shale Leasing Program. This analysis reflects the work of more than a dozen scientists and other experts and is submitted to assist you in reaching a decision on the proposed oil shale program.

The Environmental Impact Assessment Project of The Institute of Ecology was established in July, 1973, to help improve the quality and effect of federal environmental impact statements. In pursuit of that goal, we have assembled interdisciplinary teams of scientists capable of assessing data presented in or relevant to impact statements in several areas of environmental concern. This oil shale impact statement analysis is the first of our review projects.

It should be noted that our usual procedure will be to analyze draft impact statements rather than final statements. However, we recognize that regulations under the National Environmental Policy Act require a delay between issuance of a final statement and a decision on the proposed action, which permits public comment on the final statement. In many cases over the past few years federal agencies have reexamined and changed their final statement or have postponed, modified, or abandoned their proposed action in the light of public reaction during this period. We undertook this analysis with these considerations in mind and in response to concern expressed by the Board of Trustees of The Institute of Ecology about the potentially immense environmental effects of the proposed oil shale program.

We trust that the Department of the Interior, which has already devoted so much time and work on its final oil shale impact statement, will remain flexible and responsive to the material presented in this analysis. Certainly we hope that it will help you in making the difficult decision presented to you.

Sincerely,

Malcolm F. Baldwin

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SECTION 1

PURPOSE AND INTRODUCTION

I. PURPOSE OF THE REVIEW

The Environmental Impact Assessment Project of The Institute of Ecology has undertaken this review of the final Environmental Impact Statement (EIS) on the Department of Interior proposed prototype oil shale leasing program. We have attempted to provide scientific criticism and information to help the Secretary of Interior decide the fate of the proposed program. Experts in many disciplines participated in this review during the extremely short time period available for public comment on the final EIS.

The major purpose of this review is to review the final EIS, and in this context the program itself will be discussed. Program design, alternatives, environmental impacts, public participation, and legal aspects are all examined. The review includes findings and recommendations directed at assisting the decision-making process within the Department of the Interior.

II. THE PROPOSED LEASING PROGRAM--A THUMBNAIL SKETCH

The stated objectives of the proposed prototype oil shale leasing program are as follows:

> (1) Provide a new source of energy that will increase the range of energy options available to the Nation by stimulating the timely development of commercial oil shale technology by private industry;
> (2) Insure the environmental integrity of the affected areas, and concurrently, define, describe, and develop a full range of environmental safeguards and restoration techniques that can be reasonably incorporated into the planning for a possible mature oil shale industry in the future;
> (3) Permit an equitable return to all parties in the development of this public resource; and

> (4) Develop management expertise in the leasing and supervision of oil shale resource development in order to provide the basis for future administrative procedures. (III-I-1,2).[1]

The proposed program would involve the leasing of six tracts of public oil shale land, each tract comprising not more than 5,120 acres. From a list of tracts nominated by industry and state governments, the Department's Oil Shale Task Force selected two tracts each in the states of Colorado, Wyoming and Utah. The Department anticipates that operations of at least 50,000 barrels per day would eventually be developed at each tract.

The leases will be let on the basis of competitive bids, and the Department anticipates that only companies with well-advanced oil shale processing technology will participate in the program:

> In the early stages of an oil shale industry, the number of bidders may be limited by (1) lack of an economically proved technology and (2) large investment commitments that may exceed $200 million or more for each lease to be developed. (III-I-6).

A draft EIS was released by the Department in June, 1971. Because of severe inadequacies in this analysis, it was subsequently labeled a "preliminary" draft, and another draft, much expanded, was released in September of 1972. After public hearings, comment by the public and other agencies, and revision, the final statement under discussion in this review was released August 30, 1973.

The Department permitted sixty days following the release of this 3,200 page EIS for public review and comment. Presumably after reviewing comments received during this period, the Secretary of the Interior will make a decision as to whether to proceed with

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1. Reader's note: III refers to Volume III of the EIS, I-1,2 refers to the pages quoted. Hereinafter, references to the EIS will be cited in this same manner.

the leasing program.

III. PROGRAM DESIGN

The proposed prototype leasing program is, as stated by the Department, an attempt to stimulate the timely development of oil shale, with due regard to environmental protection. The program is an experiment. It is hoped that it will provide information on all aspects of oil shale development, prior to any decision to lease larger quantities of public land as part of a "full-scale" development program. It has been stated that information gained from the prototype would indicate whether to proceed with further development on the public lands.

We question whether the program as designed will provide the necessary information for objective analysis of oil shale development.

A prototype in any field must be carefully designed to meet stated objectives. The number of variables must be carefully limited through the use of controls so that the results can be reliably interpreted with respect to the objectives. The proposed oil shale leasing program is notably deficient in controls. The scale of the proposed leases and operations only augments the problem of too many uncontrolled variables.

Questions addressed by the proposed oil shale program fall into three wide categories:

(1) economic feasibility,

(2) technological alternatives,

(3) environmental impact and/or environmental protection.

Within each of these categories there are many variables. Although proponents of the proposed prototype leasing program hope that meaningful and accurate data will be found in all of these areas, the program is simply not designed in such a way that this would be possible.

The existence of numerous subsidies to participating companies (including exemption from paying "extraordinary" environmental costs), the fact that companies with new, relatively untested technologies will not be able to participate, and the inadequacies of environmental protection safeguards including the absence of good monitoring, all detract from the ability of this program to answer the relevant questions.

These problems create substantial doubt about the wisdom of proceeding with the proposed prototype programs as opposed to an experiment designed specifically to answer technological and environmental questions that trouble us today.

As presently proposed, large tracts of federal land will be leased on the basis of bonus bids, without consideration of technologies or varied environmental impacts, in anticipation of oil shale operations of at least 50,000 barrels per day. Leases will simply go to the highest bidders. Therefore, companies with untested technologies will not participate in such a program, even though there exist a number of innovative ideas for oil shale processing for which experimental-level developments would be appropriate. In this way, the federal program will effectively cut

off from public land the new technologies that might have less adverse impact on the environment and that might eventually be competitive with those that are now further advanced. Unfortunately, the EIS reveals no analysis of the technology assessments of various oil shale program alternatives. Indeed, the opportunity for encouraging and directing oil shale technology in the public interest might be severely diminished by the proposed program.

IV. THE EVALUATION PROCESS

It is an axiom in industrial research that while it is relatively easy to initiate a research program on the basis of a felt and/or demonstrated need, it is extremely difficult to terminate such a program. Although the prototype concept suggests that evaluation and reassessment should be an integral part of the program--with the decision to terminate or modify always possible--the particulars of this program do not fit this description.

In addition, the eventual decision on whether to open up more federal oil shale reserves will be based on information gained in the prototype experience. If the information is not adequate or broad enough, the quality of the decision-making will necessarily be poor or too narrowly based. The design of the proposed program, including the provisions for monitoring, is not adequate to provide the necessary information.

It is also critical to consider the process and participants in future decision-making because these too have long-term effects. If the prototype leasing proposal is approved, the Department

of Interior will be the promoter of the program. The appropriateness of the same agency serving the functions of environmental regulator and evaluator should have been questioned and evaluated in the EIS. Available options to remedy such a potentially important role conflict include greater participation of other independent agencies and the general public. At the end of this review we include additional observations on this important topic.

V. THE REVIEW

The final EIS is reviewed in this document as comprehensively as possible, given the Department's timetable.

Section 2, that follows, presents our findings and conclusions.

Section 3 of this review considers energy alternatives. An attempt is made to place oil shale development in the perspective of the uncertainties of energy "demand" projections, and to emphasize the possibilities and desirability of a national energy policy that stresses energy conservation and development of new technology.

Alternative program designs are considered in Section 4. The team felt that examination of alternatives in the impact statement was inadequate, and that the authors failed to provide justification of the proposed program in relation to other possibilities that might serve the goals of the Department and respond to the public interest.

Section 5 comprises a critique of the EIS by scientific discipline. Experts in several areas critically examine the EIS and highlight potential environmental impacts of oil shale development. Hydrology, geology, air quality, biological impacts, socio-economic considerations and certain off-site impacts are discussed.

Section 6 provides an analysis of public contributions to the environmental statement process, after issuance of the draft statement and an evaluation of the degree to which the Department responded to this participation in a meaningful way.

Section 7 contains a description of ongoing studies and other potential contributions to the oil shale program at the regional, state and local level. It discusses in particular, the joint state-federal-industry studies in Colorado, to be completed by the end of 1974.

Finally, Section 8 deals with certain legal aspects of the environmental statement, the proposed program, and the proposed lease.

Following this last section are recommendations of the review team aimed at the policy decision on the oil shale program, and at needed improvements in the lease itself.

Members of the team and the staff of the Environmental Impact Assessment Project are listed at the end of this document.

SECTION 2

FINDINGS AND CONCLUSIONS

I. FINDINGS

A. The EIS for the proposed oil shale leasing program is deficient in significant respects, including the accuracy of the data, the extent of the analysis and the manner in which the material is presented.

B. The EIS fails to give thorough consideration to alternatives and their environmental impacts: available program alternatives are dismissed, despite environmental impacts that may be less severe than those of the proposed program; energy alternatives are neglected on the basis of incomplete information and unsubstantiated assumptions.

C. Data on environmental impacts of the events to be caused by oil shale development are not presented or analyzed systematically. Critical cause-effect relationships, such as the ecological changes which might result from anticipated reductions of wildlife, or the environmental impact of offsite power generation, water supply and transportation, were misunderstood and/or neglected by the authors of the EIS.

D. The EIS evidenced a recurring tendency to over-estimate the importance of the proposed program to beneficial ends (energy supply, economic gain) and to under-estimate its importance with respect to adverse impacts (environmental damage of many types). Conversely, alternatives are characterized with the reverse emphasis.

E. Although large quantities of data are presented in the EIS, it lacks a balancing procedure by which decision-makers and the general

public can weigh competing factors. Cost-benefit analysis, which can be a useful aid to such balancing, was not employed in the EIS.

F. The EIS neglects analysis of the environmental effects of potential conflicts posed by the proposed program with existing federal and state air and water pollution laws and suggests no measures to mitigate the many adverse impacts that can result from contradictions and legal loopholes in the program's lease form.

G. The EIS made no attempt to analyse the severe environmental changes likely from development of a mature oil shale industry despite implications that steps will be taken under the proposed shale program which may be practically and politically irreversible.

H. Despite its deficiencies, the EIS outlines clearly the immense magnitude of potential adverse environmental impacts of the proposed oil shale program. In this light alternative program design could be reconsidered and the lease redesigned as a mitigating factor.

A. Energy Alternatives

1. The examination of energy alternatives in the EIS is based on questionable assumptions about energy demand and probable oil shale development by 1985 that are neither explained nor substantiated.

2. No national energy policy is sufficiently defined to place potential oil shale development of any given size in a logical policy perspective within which to assess its environmental effects or energy benefits.

3. On the basis of the analysis in the Energy Alternatives volume of the EIS, shale oil production in the optimistic projection of 1 million barrels per day by 1985:

a. would not provide a significant portion of U.S. needs and/or desires by that date and

b. is no more likely to occur than reductions in energy demand and/or development of other "unconventional" or conventional energy alternatives, and in some cases is even less likely.

4. Positive policies to encourage attractive alternatives to oil shale development, in particular, energy conservation and certain innovative energy technologies, were not presented and analyzed in the EIS.

5. Economic factors such as changing costs and prices have not been considered in the EIS for their potential impact on energy alternatives and energy consumption projections.

B. Program Alternatives

1. The proposed oil shale leasing program is not based on a thorough analysis and review of the alternatives; it appears, rather, that a single program proposal was first formulated, and a cursory examination and rejection of alternatives was then written for the EIS. No serious consideration has been given by the Department to altering the program design.

2. The proposed program is not designed to meet the supposedly experimental purpose of leasing public lands at this time. The large scale of the proposed "prototype" operations belies any attempt to encourage technologies which might be less environmentally hazardous than those which are advanced now.

3. Alternatives such as a well-designed and diverse government experiment, a three-mineral industry, or private development on private land have not been analyzed adequately (if at all) in the EIS, despite apparent potentials for less adverse impact and more beneficial return.

4. The present program involves significant risks to the public, the government, and the participating companies which have not been analyzed in the EIS. As a consequence, alternatives whose risks might be fewer have not been examined in this light, if at all.

5. At each phase of an oil shale program, alternatives exist for mining, processing, waste control, environmental protection and evaluation of the program itself. Even with respect to these alternatives, the EIS is sadly deficient, and fails to give the reader the opportunity for comparative evaluation.

6. The tract selection process--an opportunity for considering alternatives within the framework of the proposed program--was carried out without due consideration of the many environmental and technical problems. Instead, tracts were selected which were apparently attractive to certain companies but which had severe ground water problems and unusual environmental values.

C. Physical Impacts

1. Hydrology

a. The description of water demand and supply summarized in the EIS purports to be quantitative, but it fails to provide the reader with a factual basis for estimating the water demands and the environmental impact of disposing of the excess saline water.

b. The ranges of estimated water usage are so large that it appears that essentially nothing is known about the water needed by the operation or to be produced from the mines. The EIS fails to make clear whether these imprecise estimates are due to time variations, or from from a lack of information for a particular phase of the operation. Thus, the estimated demands and discharges of water appear to be quantitative when in fact they are far from definitive.

c. A broad interpretive discussion of the available water resource at each site and in the basins concerned, and the relation of these water quantities to the proposed uses and potential environmental impact of these uses was not given. This could have been provided by the U.S. Geological Survey in the EIS.

d. With oil shale plants*on both Colorado tracts, saline waste waters from mine dewatering might reach a maximum flow of 110 cfs. The EIS does not discuss the potential adverse impact of these waste waters on the Colorado River, though the impact could be considerable.

*of 100,000 barrel per day capacity each

e. Available groundwater data from near the Colorado tracts indicate serious problems may arise in that area. Other rich oil-shale sites in the Piceance basin appear to present fewer groundwater problems. Use of the latest available hydrologic data would dictate re-evaluation of all tracts nominated in Colorado.

f. The environmental impact of spent shale piles and their possible contribution by leaching and mass wasting of soluble salts to the Colorado River is not evaluated in the EIS. Calculations show that even if 1% of the salt in the spent shale piles were to escape into the tributaries and into the Colorado River, the damage would be severe to downstream users--about $5 million by 1999.

g. The alternative of returning most spent shale tailings to mines was not properly evaluated in the EIS and no such requirement is provided in the lease. Reburial of tailings in the same levels from which they came would create far less threat of leaching than would outdoor storage.

2. Air Quality

a. The EIS admits that if the oil shale program is implemented, significant degradation of air quality will occur.

b. Evaluation of air pollution burdens by means of a simplified Gaussian plume model, as described in the EIS, is inadequate. This dispersion model must be applied for conditions existing at the emission sites and should be validated by use of tracers.

c. There is no evidence indicating that ambient air standards can be met by the proposed oil shale development; in fact, it is admitted that SO_2 standards cannot be met.

d. The air monitoring system proposed in the lease is not adequate, and places authority in the hands of the Mining Supervisor, whose expertise lies in other areas.

e. Little attention has been paid in the EIS to possible pollution episodes. Similarly, photochemical smog formation has not been dealt with.

f. An evaluation of the regional air basins involved in the six selected tracts is needed to judge the susceptibility of the drainage to inversions.

3. Geology

a. The EIS is deficient in its analysis of hydrological problems, particularly with respect to the large quantities of waste water involved. For example, for two plants of 100,000 barrels per day capacity operating on the Colorado tracts, we calculate that the maximum anticipated flow from pumping low-quality (saline) water from the mine operations would equal 219 acre-feet (70,000,000 gallons) of water per day; this is enough water (if potable) to supply a community of about 395,000 people. The environmental problems associated with handling such effluents are of far greater magnitude than the EIS indicates.

b. The EIS does not evaluate the potential impacts of trace metals as potential environmental contaminants.

c. The quantities and value of the mineral resources in the oil shale region are not described or evaluated in detail in the EIS. This omission denies the reader the ability to judge the irreversible commitment of these resources.

D. Biological Impacts

1. Revegetation

a. Technology for revegetation of potential land disturbances associated with the development of the prototype leasing program is not presently available.

b. Establishing productive, stable plant cover on spent shale is a particular problem which there is no reason to believe technology will solve within the 20-year lease period. Efforts to revegetate spent shale may cost as much as $5000/ acre; the government, not the industry, may end up paying for it.

c. The lease contains a strong revegetation objective that is all but negated by other provisions.

d. The Mining Supervisor lacks expertise necessary to manage revegetation efforts on behalf of the public. The EIS includes no discussion of alternate mechanisms for supervision, such as by the Environmental Protection Agency.

2. Wildlife

a. The major impacts on wildlife from oil shale development on the public lands would be upland habitat losses from the mining operations, loss of riparian (streamside) habitats and water in canyon bottoms from disposal of saline spent shale, impacts from noise and disturbance that would eliminate big game over large areas, and impacts from the influx of people that would use the area for recreation.

b. Wildlife impacts of an oil shale industry in Colorado would be less if the developments were planned

for public or private lands or the periphery of the Piceance Basin. This was not discussed in the EIS.

c. The EIS reveals that wildlife values received only minor attention in the course of oil shale program design and impact analysis. The expressed national policy of preservation of rare and endangered species has received similar lack of emphasis.

d. Lacking sound quantitative data on wildlife and fish populations, the EIS assessment of impacts on the vertebrates are speculative, unanalytical and inconclusive. Substantial impacts would, of course, occur.

e. The EIS lacks examination of ways in which wildlife species can be conserved, even including rare and endangered species.

f. The lease lacks effective provisions for protection of wildlife.

g. The EIS does not discuss efforts that might maintain wildlife populations during operations. A cooperative state-federal wildlife management plan with maintenance of wildlife as its objective would have been one mechanism to examine in the EIS.

E. Social Considerations

1. Economic Analysis

a. Economic benefits are quantified in the EIS in terms of maximum possible development, while likely environmental costs are incompletely presented. This technique makes the potential for economic benefit loom deceptively large over the potential environmental harm.

b. The concept of price-demand elasticity is ignored in the EIS as if it did not apply to oil shale at all.

c. The benefits and costs of oil shale development have not been presented in a manner to show how they might be balanced by federal decision-makers or by the public.

d. Data used to compare economic benefits and environmental costs are biased in favor of oil shale development while the alternatives and the optimal use of the resource are not systematically evaluated.

e. The lease stipulations dealing with environmental protection suggest that many of the costs, particularly long-term costs, such as revegetation and maintenance of dams and conduits, may be paid out of public funds.

f. Certain basic economic tools, such as price-demand elasticity and cost-benefit analysis, are not applied in the analysis of energy alternatives, limiting the usefulness of the EIS as a helpful decision-making document.

2. Regional Impacts

a. EIS data on regional impacts are incomplete and poorly documented.

b. The EIS failed to outline the positive and cooperative steps the federal government could take at this stage to alleviate such problems as anticipated financial burdens on local communities.

c. The EIS did not discuss the need for a regional development plan indicating the number, scope and magnitude of major offsite changes, such as reservoirs, roads and transmission lines, caused by the development of oil shale.

d. The EIS's only suggestion for mitigating adverse socio-economic impacts is that "Careful planning at the local level will be required for orderly growth and development." (I-III-30) The serious difficulties that local governments will have in responding to this recommendation are ignored.

3. Aesthetics

a. Aesthetic analysis in the EIS is not sufficient even to establish baseline information.

b. The EIS evidences no clear conception of the meaning of aesthetics or its relationship to other social concerns such as recreation and tourism.

c. The lease, which seeks to protect aesthetic values, lacks definition or data necessary to obtain and analyze baseline data relevant to aesthetics.

F. Off-Site Impacts

1. The EIS contains no analysis of the off-site impacts of major supporting facilities necessary for oil shale development. These include large electrical generating plants, major reservoir, diversion, and pipeline facilities for water supply, and highways and other utility corridors.

2. The EIS does not consider the secondary impacts resulting from the large influx of people required to operate and support a regional oil shale industry. These impacts go beyond basic land requirements to water and power supply, sanitation, recreation and other predictable impacts attendant to rapid urbanization.

3. The probability of ancillary industrial development is mentioned, but concommitant problems of land use, water supply, air quality, etc. are not analyzed.

G. Public Participation

1. Review time for both the draft and the final EIS was insufficient to permit thorough public review and comments, despite some time extensions by the Department. No apparent attempt was made to match the permitted comment period with the complexity of the issue and the length of the material presented.

2. No systematic attempt by the Department was made to separate the minor from the major points and questions presented by the public. Mechanisms to do so, such as the enlistment of help from recognized environmental groups, were apparently not employed.

3. Analysis of important comments presented by the public indicates that the Department frequently neglected to answer or recognize the questions raised in the EIS. Some aspects of the water data, i.e. unallocated water in the Colorado River, were taken up by witnesses more adequately than they were treated in the EIS.

4. Future opportunities for public participation in the oil shale lease program are virtually non-existent.

H. State Input/Cooperative Studies

1. Since the Colorado oil shale areas are richest in shale oil and have the best chances of receiving bids, it is particularly important that environmental problems there be evaluated carefully.

2. It appears probable that Interior, industry and the public will not have access to important Colorado state oil shale environmental studies before the lease terms are completed since some unpublished state study reports will not be available or complete until 1974. Some important ground water data gathered for the state ready for release since the spring of 1973 are still withheld by Interior. The data not referenced in the EIS would have been helpful in public evaluation of environmental impacts.

3. The EIS makes no pretense of determining the relevance or value of the state environmental studies to the federal evaluation of the oil shale program. The importance of any new data to be forthcoming from these state studies is never examined within the EIS, and no analysis has been made of the benefits gained from postponing leasing until after completion of these studies.

I. Legal Analysis

1. Policy Conflicts

a. The proposed oil shale program presents conflicts between the demand for energy and national policies favoring and/or requiring protection of water, air and wildlife.

b. The EIS does not analyze these conflicts despite the potential for legal violations arising out of the program and despite the significant environmental impacts that might result.

c. The EIS fails to analyze the impact of a mature oil shale industry, even though it is clear that the institution of the proposed program would establish momentum for expanding development, even at the expense of other energy options.

d. The EIS discussion of energy alternatives is skewed, in that alternatives are compared to 1 million barrels per day of shale oil, rather than to the relatively insignificant 250,000 barrels the prototype program itself would provide by 1975.

2. Lease Analysis

a. Assurances of environmental protection in the EIS depend largely on lease provisions, which, however, have significant gaps likely to adversely affect the environmental quality of oil shale region.

b. The EIS did not systematically examine the implications of alternatives to the proposed lease arrangements.

c. Environmental protection provisions in the lease lack specificity and criteria by which the federal govern-

ment can judge and regulate operations of the lessee likely to have a significant environmental effect.

d. The EIS lease provides for the traditional broad discretion of the Mining Supervisor employed in non-experimental mining situations, and the EIS does not analyze the environmental implications of his powers, despite problems of a lack of relevant expertise and the omission of strong environmental criteria in the lease.

e. Separation of Interior's promotional function in the oil shale program from its regulatory role was not examined in the EIS. Instead, the EIS dismissed without analysis the suggestion that the Environmental Protection Agency assume control over all environmental monitoring and analysis.

f. The value of public participation in ensuring environmental protection was not evaluated in the EIS. Neither mandatory public hearings nor mechanisms for meaningful public participation in critical regulatory determinations was discussed.

g. The EIS did not examine alternative public information policies by which information and reports of lessees relevant to environmental protection could be made publicly available.

h. Various critical lease provisions, such as those on lessee deductions from royalties for "extraordinary" environmental costs, lease terms, and bond amounts were not evaluated for environmental effects and alternatives. These, in effect, are subsidies.

SECTION 3

ENERGY ALTERNATIVES

I. ONE MILLION BARRELS PER DAY

Volume II of the EIS, "Energy Alternatives," is based on the assumption that if shale oil is not produced at the rate of 1 million barrels per day by 1985, we will have to "find" that quantity of oil (or its equivalent) over and above any other projected source of production in that year. Or, as the final statement emphasizes more than the draft, we will have to save that quantity of oil or its equivalent through conservation measures.

One million barrels a day of oil from shale oil production by 1985 is highly optimistic, expecially in view of the fact that the most optimistic estimate for shale oil production from the proposed program on public lands is 250,000 barrels per day by that date. Much of the balance is assumed to be stimulated on private lands by further federal leasing programs.

II. UNCERTAINTIES OF PROJECTION / BURDEN OF PROOF

In reality, neither the demand for energy in 1985 nor the oil shale development potential for 1985 is known with any certainty. The EIS fails to distinguish between energy need and energy consumption. The statement's projection of energy consumption may well be an estimate of what could be consumed by a given date, but is neither an estimate of our requirements nor a prediction of what will be consumed. It is therefore misleading to imply, as does the final environmental statement, that we need 1 million barrels a day of oil from oil shale by 1985 unless proven

otherwise. Yet this is the Department's approach. (II-V-1, V-44, V-62, V-161, etc.)

The initial sections of the volume on Energy Alternatives are devoted to an examination of the relation between energy use and economic well-being (II-II-1 through II-5) and an exposition of the Department's projections of growth in energy consumption over the next few decades (II-II-5 through III-28). The former is an endorsement of growth in energy use. The latter, representing Interior's energy consumption projections, is an extrapolation of exponential growth trends in our immediate past.

A special report to the U.S. House Committee on Interior and Insular Affairs noted the shortcomings of energy demand "forecasts," including forecasts by the Bureau of Mines and the Department of Interior:

> Most of the studies are fundamentally deficient for their failure to deal with an exact energy concept, their analyses are usually only loosely structured to address some vague notion of energy demand, and little attention is given to a correct interpretation of the forecasts. The crucial issues of price and supply limitations are usually all but ignored. Perhaps most important of all, many studies seem to suggest that their forecasts can be used by policy-makers as target levels for future energy consumption.[1]

Although admitting a certain amount of fallibility, the authors of the EIS posit:

> ...the energy demands forecast should be considered as order of magnitude levels to provide planning targets and not as absolute commodity demand predictions. (II-II-11, emphasis added.)

With the potential for shale oil production and the projection

1. U.S. House of Representatives, Committee on Interior and Insular Affairs, "Energy 'Demand' Studies; An Analysis and Appraisal," Sept. 1972, #80-651, p. 7.

of energy need both quite uncertain, the analysis contained in the "Energy Alternatives" volume belies the complex and controversial questions involved.

III. ALTERNATIVES

The authors of the EIS consider alternate sources of energy, as well as energy conservation, in terms of what is most likely to happen (for the most part without extraordinary policy exertion). (II-V). The general rule of thumb seems to be that if production in any one of the other source sectors were to surpass previous expectations, the "excess" could lessen our need for the one million barrels of shale oil. Similarly, energy conservation (which is not assumed in the projections used) and/or slower population growth than anticipated could substitute for one million barrels of oil shale oil by 1985.

A. Energy Conservation

The treatment of energy conservation in the final EIS is vastly improved, by more detail over the material included in the draft. Nevertheless, it is depicted as an unlikely occurrence in our "energy consuming society presently committed to increased energy consumption." (II-V-1.) The potential impacts of price elevation and supply shortages are not evaluated. (Section 5-III-A of this review for an economist's discussion of price-demand elasticity.)

Even without an evaluation of the impact of price and supply limitations on energy consumption, many of the energy conservation possibilities discussed do not inevitably fit the characterization attributed to them by the EIS -- requiring "intensive social and

legal changes." (II-V-1.) Indeed, the obvious difficulties inherent in attempting to accommodate an almost 50% increase in per capita energy consumption between 1970 and 1985 (II-V-3) seem astronomical in comparison to the rather modest efforts at energy conservation which could lessen or prevent that increase.

The EIS cites a recent report of the Office of Emergency Preparedness on the subject of energy conservation. But the most significant conclusions of that report are not discussed -- that major reductions in energy demand can be accomplished in the near future, without lessening our standard of living or altering lifestyles. As the abstract to the OEP report states:

> This study suggests that energy conservation measures can reduce U.S. energy demand by 1980 by as much as the equivalent of 7.8 million barrels per day of oil (equal to about 2/3 of projected oil imports for that year).
>
> The most significant realizable measures to effect conservation are:
>
> a) improved insulation in homes,
> b) development of more efficient air conditioners,
> c) shift of intercity freight from highways to rail; intercity passengers from automobiles to mass transit; and from consolidation in urban freight movement, and
> d) introduction of more efficient industrial processes and equipment.[2]

Although the EIS includes discussion of many possible conservation measures, it states:

> ...long periods are required before any significant impact on net energy consumption patterns of the United States is seen, even assuming that general acceptance by the public can be obtained. (II-V-9.)

2. Office of Emergency Preparedness, The Potential for Energy Conservation, U.S. Government Printing Office, Washington, D.C., 1972.

It should be noted that oil shale development will be far more difficult to accomplish within a short time than will many conservation measures. Even a fraction of the savings discussed by the Office of Emergency Preparedness as attainable by 1980 would obviate the "need" for 1 million barrels per day of shale oil by 1985.

From the information available on potentials for energy conservation, it seems clear that national policy could place high priority -- even to the extent of a "crash" program -- on such conservation measures as are mentioned in the EIS and the OEP report. These opportunities do in fact represent alternatives to continued hasty exploitation of finite fuel reserves.

B. Supply Alternatives

The EIS authors consider a variety of supply alternatives, ranging from increases in petroleum to increases in other forms of energy, both conventional and unconventional. The explicit or implicit conclusion of each discussion is that oil shale development in the amount of 1 million barrels per day by 1985 is more likely, more appropriate, and/or more desirable than other supply options. (As has been stated above, the entire discussion centers on the assumption that 1 million barrels per day from oil shale or some equivalent must be found.) The authors conclude that increased imported oil is "for some time to come the basic alternative to the production of one million barrels of shale oil." (II-V-193). However, there are severe weaknesses in the discussion of alternative supplies, particularly increased onshore conventional oil production and development of "unconventional" sources, such as

geothermal and solar, or improved technologies, such as magnetohydrodynamics.

1. Onshore Production of Oil

The EIS states that "an increase of only 1 percent in the average recovery of oil-in place would yield 4.25 billion barrels, or 2 million barrels per day for 12 years." (II-V-64.) The authors are not optimistic, however: "...further dramatic increases (in recovery techniques) are generally not anticipated at current costs and price levels." (II-V-65, emphasis added.)

As has been indicated above (and as is discussed in Section 5 of this review) the assumption of static costs and prices robs the analysis of meaning. To make a credible judgment on possible improvements in recovery techniques, one would have to evaluate the probable impact of price and cost increases.

The economic viability of oil shale development has not yet been established. Improvements in onshore oil recovery technology are at least as likely to be economically sound as development of 1 million barrels a day of shale oil by 1985, with the likely advantages of far less significant effects on the environment.

2. Unconventional Energy Sources

Oil shale as an energy source is at least as "unconventional," "exotic," and "undeveloped" as the technologies that are joined together under these descriptions. Under "Other Energy Sources," (II-V-171) it is stated,

> At present, these alternatives (such as solar, magnetohydrodynamics, wind) are not considered viable due to a lack of proven technology for production scale application, nonsubstitutability, cost, and timing of development.... Potential environmental impacts of these alternatives are difficult to assess, particularly where there is a great amount of research and development that must be done before operational scale systems can be developed, tested, evaluated and readied for production application.

It is difficult to distinguish oil shale from other unconventional sources of energy on the basis of the above description. Oil shale technology for the most part is in its infancy and at the very most will contribute 1 million barrels of oil per day by 1985 -- over a decade away.

As a particular example of an unconventional energy source, geothermal production is discussed:

> Currently 298 Mw capacity is in operation at the Geysers producing about 8.9 trillion Btu each year. In comparison, the projected shale oil production of 1,000,000 barrels per day is equivalent to approximately 850 trillion Btu annually (equivalent electrical energy), or about 100 times as great as the present geothermal potential. Thus, geothermal is not a viable alternative to this amount of shale oil production. (II-V-161, emphasis added.)

From the facts recited here geothermal production is already far ahead of oil shale (298 Mw compared to zero barrels per day). Comparing an optimistic projection for oil shale development to a demonstrated existing capacity for geothermal generation hardly indicates that geothermal production is a less likely candidate for significant energy production in 1985!

The EIS discussion of most "unconventional" energy sources is cursory. As another example of misleading analysis,

the two-page treatment of solar energy deals only with potentials for electricity generation. Solar heating and cooling is technically feasible today, and as the National Science Foundation has said:

> There is not doubt that among all the possible uses for solar energy, residential heating and cooling has the highest probability of success. There are the least uncertainties both in the technology and the economics of these domestic applications. There is, moreover, a very high benefit/cost ratio...[3]

Perhaps more important than speculation as to which innovative energy technologies might come on line at what point is the thorough consideration of which technologies might have the least environmental impact or might diminish our reliance on non-renewable sources of energy. These policy objectives can and should provide important guidance in analyzing energy options.

In the 1985 time frame considered in the EIS, the possibility is left open that concerted action to improve energy systems (such as the ones mentioned in II-V-10) would provide attractive alternatives to oil shale development by 1985. A comparison of the many and significant adverse environmental impacts of oil shale development to those of innovative alternatives alone suggests that national energy priorities in the next decade could be directed toward development of the latter.

3. Combinations of Alternatives

In an improvement over the draft environmental statement, the

3. NSF/NASA Solar Energy Panel, "Solar Energy as a National Resource," 1972.

authors suggest in the EIS that a combination of the many alternatives mentioned might provide an alternative to oil shale development. Especially in view of the fact that 1 million barrels per day of oil in 1985 will be a small fraction of our total energy budget, it is probable that no one alternative -- including oil shale development -- will provide the whole answer.

The authors of the EIS conclude, however, that increased oil imports in the amount of 1 million barrels per day in 1985 is the most likely alternative of them all. (II-V-193.) The EIS does not present sufficient data and analysis to show why the oil import alternative is more likely than a combination of options.

To apparently clarify the complex interactions of energy policy, the authors of the EIS have provided a chart which is described as "an effective way to view a complex problem." (II-V-187.) It is reproduced on the following page. Its clarity and utility are not evident.

IV. CONCLUSIONS

1. The examination of energy alternatives in the EIS is based on questionable assumptions about energy demand and probable oil shale development by 1985, that are neither explained nor analysed adequately.

2. No national energy policy is sufficiently defined to place potential oil shale development of any given size in a logical policy perspective within which to assess its environmental effects or energy benefits.

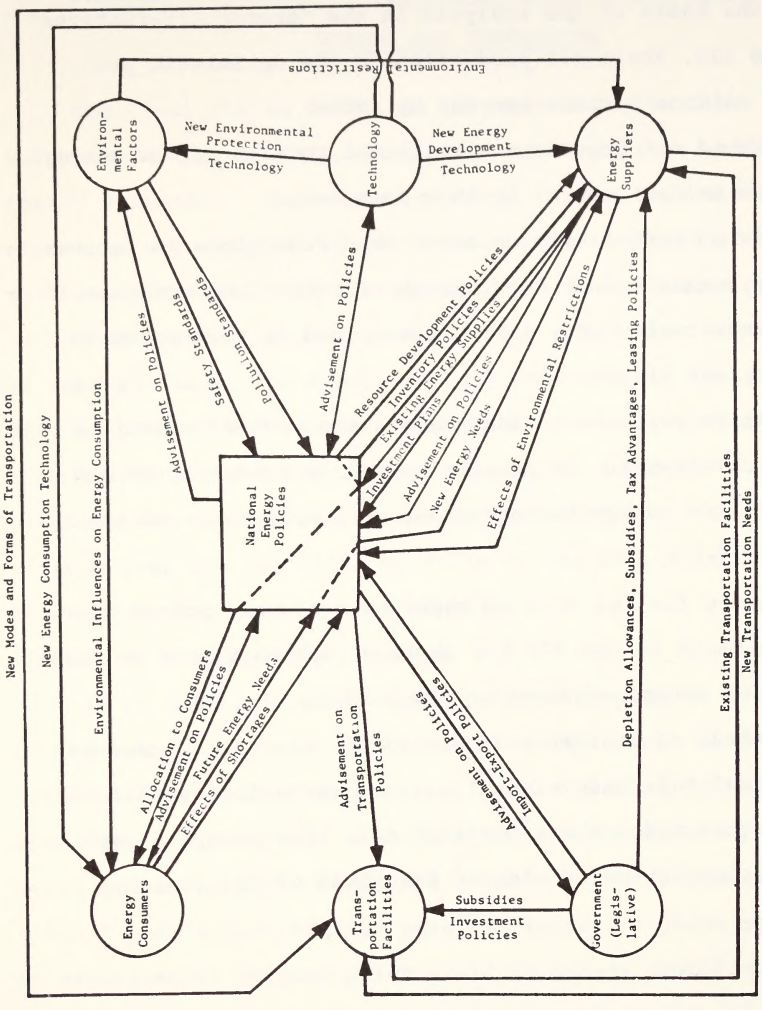

Figure V-3 - Energy Policy Interactions.

Source: (Ref. 122)

3. On the basis of the analysis in the "Energy Alternatives" volume of the EIS, shale oil production in the optimistic projection of 1 million barrels per day by 1985:

a. would not provide a significant portion of our energy needs and/or desires by that date and,

b. is no more likely to occur than reductions in forecast energy demand and/or development of other "unconventional" or conventional energy alternatives, and in some cases is even less likely.

4. Positive policies to encourage attractive alternatives to oil shale development, in particular energy conservation and certain innovative energy technologies, were not presented and analyzed in the EIS.

5. Economic factors such as changing costs and prices have not been considered in the EIS for their potential impact on energy alternatives and energy consumption projections.

6. Oil shale as an energy source is at least as "unconventional," "exotic" and "undeveloped" as some technologies that the EIS joins together under these descriptions. For example, geothermal energy production is already far ahead of oil shale development.

SECTION 4

PROGRAM ALTERNATIVES: OIL SHALE DEVELOPMENT TECHNOLOGY, MINING AND PROCESSING

The final EIS is deficient in presenting the major alternatives which, according to NEPA, should appear in a final environmental impact statement. The reader can only assume that alternatives not presented and analyzed in the volumes have not been officially reviewed and evaluated by the Department. The EIS does present alternative types of prototype mining and extraction considered to be appropriate to the tracts already selected for the program. But, as pointed out in the Introduction to this review, this program design process has already eliminated a number of promising alternatives which deserve far greater attention. In that these alternatives are not taken up fully in the EIS, this review attempts to characterize some of them briefly.

I ROLE OF THE PROTOTYPE PROGRAM

It is important to analyze the prototype phase in the context of the entire proposed leasing program sequence. According to the original Program Statement for oil shale leasing (June 1971), the prototype program would seek to allow private industry to develop small oil shale plant equipment "under carefully controlled conditions," and "assure minimum possible impact." These goals suggest an experimental program which would encourage comparison and evaluation of various technologies in an attempt to use oil shale in a way that is environmentally sound and efficient.

Economic principles and factors are an essential part of prototype design. Economic risks of a prototype program on the

scale proposed are significant to the companies, to the government and to the public. The EIS lacks analysis of alternatives with respect to their economic risks and benefits.

If the prototype is indeed to provide an opportunity for testing and evaluating diverse technologies on the public lands, it should be made clear in the decision-making phases of the program what alternatives exist. These alternatives should have been described in the EIS in detail comparable to the proposed program alternatives. It should be noted here that many options exist which would more directly address the expressed experimental goals of the Department.

II. TECHNOLOGIES POSSIBLE ON THE SELECTED TRACTS

The six tracts proposed for leasing in the oil shale program vary in quality of deposit, suitability of extraction technologies and amount of land area required for development. Hydrological characteristics (see Section 5-I-A) also vary significantly -- for example, the Colorado tracts are underlain by amounts of saline water so immense that mining will be extremely difficult.

It should be noted that the Wyoming tracts, by virtue of the relatively lesser quality of oil shale and the lack of interest demonstrated by industry in the tract nomination process, are not particularly attractive to potential lessees.

(Note: the land areas to be disturbed and/or used as a result of oil shale extraction are extremely difficult to glean from the EIS. The land areas estimated below are our best guess from the figures presented.)

A. Surface Mining

Oil shale surface mining requires an open pit or small strip mine. This technique might be possible for the C-a tract in Colorado. As a first step, overburden would be removed and permanently disposed of in a gulch west of tract C-a. A dam would be needed at the foot of this gulch (although this is not mentioned in the EIS) to protect downstream areas from massive erosion and leaching of contained salts. (Data on salts in the overburden are not given in the EIS.) The surface method would probably produce the maximum area of ground disturbance. About 6 to 8 square miles would be required over a 30 year period for tailings disposal and overburden disposal. This would vary according to the amount of material replaced in the mine ("backfill").

Land disturbance would result from mining the pit itself and from the disposal of tailings and overburden. Salts leaking from these piles present serious environmental hazards, as discussed in the Hydrology section (Section 5-I-A of this review). Air degradation would result during all phases of the process: mining, crushing, retorting, and use of supplemental fuels. Particulate pollution would be severe from above-ground crushing, though controls are possible. Environmental damage from an expected maximum of 30 cubic feet per second (cfs) of saline mine waters ("excess water") would occur here, with a 100,000 barrel per day (b/d) plant.

The primary advantage of the surface method would be economic: one can expect nearly 100% removal of oil shale layers.

B. Underground Mining, Room and Pillar

Whether entrance to the mine is by an angular adit (tunnel)

bored through a canyon wall, or by a vertical shaft, this type of operation could remove a theoretical maximum of about 75% of the shale in a single horizon (layer) leaving about 25% as pillars to support the mine roof. (Actual experience at Colony Development Operation indicates that 60% removal may be more likely.) The room and pillar method may cause the least land surface disturbance of the methods mentioned here, depending on how much of the tailings are returned to the mine hole. The EIS estimates that 60% can be returned to the mine hole (III-IV-21). Remaining tailings would be trucked or moved by conveyor belt to terraces in nearby canyons; at tract C-b, for example, tailings would be taken to canyons running northward through the tract and on its east edge. Disposal of these tailings would require about 73 acres of canyon land each year. Over a 30-year period this could consume 2 to 3.5 square miles of land on and off the tract site. Surface storage of tailings, as mentioned above, would present a serious environmental hazard because of the contained leachable salts.

One of the most serious hazards of underground mining at the C-b tract would come from mine dewatering operations because all evidence indicates that this tract is the wettest and has the saltiest water. For example, the EIS indicates that at the C-b tract, mine dewatering and other excess saline waters could produce a maximum of 40 cfs for only a small 50,000 b/d plant (see section 5-I-A on hydrology).

When tailings are to be dumped and compacted in canyon bottoms (whether from underground or open pit mining), dams are proposed to catch salty leach waters or runoff from the tailing piles.

However, the future maintenance in perpetuity of these dams and the pump-back and care of salty water so caught is not discussed in the EIS. Even though the statement covers only a prototype oil shale operation, this problem presents a very long-term environmental hazard which the EIS does not fully analyze. (See Section 5-A-1.) The EIS indicates that by compaction of the tailings leaching would be stopped forever, but this is questionable, since adequate re-vegetation is so uncertain.

C. In Situ Extraction

If developed, the Wyoming tracts may be best suited for in situ mining -- an underground pumping operation of hot liquids (water, gas or hydrocarbons) under pressure. This method would not require lands in addition to the 5120 acres included in each lease. (The two Wyoming tracts might be combined under one lease, however, because of their thin resources.)

Despite relatively lower land requirements, devastation on the land used would probably be relatively higher than other methods. It might be necessary to drill 120 or more wells per month to recover 50,000 b/d (for an unstated period of time). On a single tract, the EIS suggests that 1,140 acres might simultaneously "be active" at various stages of operation or restoration (again over an undefined period of time, III-IV-30).

It is clear that contamination of groundwater would occur. For this very experimental technology the potential adverse impacts on groundwater are not at all assessed in the EIS.

Air degradation would occur during retorting and refining.

Excess saline waters produced pose a serious problem environmentally but apparently not so serious as those at the C-a and C-b tracts from mine dewatering.

III. A METHOD OF EXTRACTION AND PROCESSING NOT POSSIBLE ON THE SELECTED TRACTS: A THREE-MINERAL INDUSTRY

Abundant and commercially minable amounts of the minerals nahcolite (sodium bicarbonate) and dawsonite (sodium aluminum carbonate) occur in the central and northern parts of the Piceance Basin in Colorado. At least five oil companies submitted nominations for tracts in which there was not only an abundance of rich oil shale, but also apparently minable amounts of these minerals. (Tracts C-1, C-10, C-11, C-6, and C-16; I-IX-213). None of these was chosen by Interior. One company has presented to the Department by letter (EIS V, Document #74) a description of an innovative technology that would utilize salts (such as nahcolite and dawsonite) encountered in the course of the oil shale mining operation. The salts would be marketed for specific uses, and pure distilled water would be produced as an effluent.

Where oil shale deposits contain greater than about 15 to 20% nahcolite and 10% dawsonite, these salts can be removed from the shale, thus reducing the final volumes of tailings to such a degree (by 50%) that they can be returned to the mines. Replacement of the leached spent shale underground eliminates ecological problems encountered by surface disposal. If the room and pillar method is used, tailings can be replaced in a "room" which can then be sealed off to prevent movement of leachates. In addition, a

1 million b/d shale plant producing nahcolite and dawsonite might use about 480,000 acre-feet of water per year. The ample saline groundwater from the "leached zone" could supply all these requirements.

This particular company notes that the EIS identifies nahcolite as an absorber of SO_2, indicating the market value of this product for smokestack scrubbers. A 1 million b/d plant from nahcolite bearing beds would produce 300 tons per day of nahcolite -- enough to scrub stack gas resulting from burning 2,000,000 tons of 3% sulfur coal per day.

Dawsonite, also a product of this type of operation, can be converted to metallurgical-grade aluminum, thereby providing a domestic source of aluminum for the United States.

Another use for these salts has been developed. A mixture of dawsonite and nahcolite compounds would be used for double coagulation of highly colored waste waters. These compounds are effective in removing phosphorous from waste waters and the combination of their application (basic sodium aluminate and acidic aluminum sulfate) encourages neutralization of compounds in waste water. (Though this technique has been developed for a small model, it needs to be tried on a scaled up commercial level. The price of the cleanup compounds is estimated to be less than $80 per ton -- well within reason for water treatment applications.)

Also of interest is the fact that sodium sulfate, one of the intermediate products of this three-mineral technology, has been identified as potentially valuable for application in solar

energy systems.

A three mineral industry facility such as this might avoid the extensive environmental problems associated with mine dewatering and disposal of saline waters. It would also be possible to dispose of all tailings in the mine hole.

The EIS should have included thorough analysis of this technological alternative, particularly in view of the potential benefits which might be achieved therefrom.

IV. OTHER ALTERNATIVES BARELY CONSIDERED IN THE EIS

A. Encouraging private development on private lands

As the EIS indicates, private holdings on oil shale lands are largely in the southern part of the Piceance Basin, though some are held in Utah. This represents a large quantity of land (235,000 acres), but many holdings represent small parcels that are not considered developable in themselves.

Three to five private companies do have tracts large enough and rich enough in oil shale to develop commercial scale operations; hence private development is possible on private lands.

The EIS suggests that "a private developer will continue to be reluctant to develop private lands first as long as the possibility exists that at some future date, as a result of leasing public lands, the high grade resources would be available...." (III-IX-26.) The EIS also postulates that since abundant groundwater exists on the public land (in Colorado) and not on the private land that "the opportunity to test various methods of managing large quantities of excess water... on a commercial scale...

would exist only on public lands." (III-IX-28.) It is hard to see why leasing tracts C-a and C-b that have such difficult groundwater problems would be attractive to an infant industry.

Another justification for "experimenting" with public lands is that more control might be exerted through the lease provisions for public lands. This is at best a theory, as a critical review of the lease will reveal. (See Section 8II of this review.) Environmental protection and controls of other kinds are simply not included in the lease form as proposed in the EIS.

Land trades between the government and private companies on a small scale might be a helpful tool in aiding private development of oil shale. Such trades, based on a fair market value for the land and the resource, would allow some of the high quality land in private hands to be consolidated to enhance the feasibility of development.

B. A True Experimental Prototype Program by the Federal Government

A notable alternative to the EIS oil shale proposal would be a true experimental prototype program designed to systematically determine the oil shale technology with the least environmental impact. Such a program would seek completion of basic research well before the bids are let, the lease is signed, and irrevocable damage to the environment incurred. The federal government could pursue research to answer the following questions and problems. Basic as they are, these questions are not adequately addressed in the EIS and therefore are now inadequately understood.

1. Explore our capability to establish self-sustaining revegetation on spent shale or disturbed soils, and its long term stability.

2. Search for appropriate ecotypes that would tolerate the tailings.
3. Seek maximum biotic productivity on the revegetated areas and vegetation stability over varying conditions.
4. Investigate tracts in Colorado that would have an appropriate amount of oil shale but that would not have excessive amounts of saline groundwater.
5. Experiment on a small scale with ways to desalinate and/or demineralize excess water.
6. Experiment with injection wells on site to see if they can work in those sedimentary facies.
7. Seek ways to salvage salts and experiment with a three-mineral technology.
8. Compute an accurate water budget for the particular site.
9. Experiment with compaction methods using spent shale and determine quantitatively its groundwater or contained water characteristics.
10. Determine quantitative soil composition for leached spent shale.
11. Obtain ash analysis of plants growing on said leached shale.
12. Determine quantitative composition of fertilizers to be attempted for revegetation.
13. Determine tolerance of fauna on revegetation plots.
14. Determine nutritive value of revegetation.
15. Determine trace elements in oil shale, in tailings and in shale oil.
16. Determine particulate emissions from retorting methods.

17. Set up a valid air monitoring system (not based on the simplified Gaussian plume method alone) in order to calculate wind roses and inversion heights at all seasons over time.
18. Make an air basin model for the areas in question.
19. Determine carcinogens in emissions from retorts.
20. Evaluate economic impact on the region for a projected future oil shale plant in a critical manner.
21. Allow time for, and encourage, state and regional governments to develop their regional planning scheme in the event of future large scale oil shale development.
22. Allow time for in-progress state environmental studies to become completed (December 1974).

The adverse environmental effects of all such small scale studies would, of course, be far less than Interior's large scale prototype program, which has no upper limits for mining capacities at the leasing sites.

The Department of the Interior has adequate resources and top quality expertise to establish a true experimental, small prototype probram. Such agencies as the Soil Conservation Service on revegetation, the U.S. Geological Survey on groundwater trace elements, the Environmental Protection Agency on environmental monitoring, the Bureau of Mines on mining technology, the Bureau of Land Management on land management and zoning design, the U.S. Bureau of Sport Fisheries for biotic productivity and impact on aquatic and riparian ecosystems could all significantly aid in addressing the problems and present unknowns.

Under such a small prototype a full range of resource development and environmental alternatives could be examined in depth

as an intermediate step before any leasing of public lands to industry.

V. TRACT SELECTION

The purpose of this section is to show that at the time oil shale tracts were nominated and selected for leasing on the public lands, that (1) environmental considerations were given very little attention, and (2) at the time not enough environmental information was at hand to assess the potential environmental problems, both local and regional, of each tract.

The tract selection for the Interior prototype oil shale program was carried out as follows (a chronology):

1. May, 1970: Interior asked the three states to indicate geographic areas of economic interest where in situ, surface, or underground mining might be developed; environmental impact was mentioned.

2. June, 1971: Publication of preliminary draft EIS "served to illustrate that a full range of development options may be expected as an oil shale industry grows to maturity across the region" (III-IX-202,203).

3. June, 1971 through November 1971: Informational core drilling by industry on public land. Sixteen holes were drilled by an unspecified number of companies.

4. November, 1971: Interior called for tract nominations from industry.

5. January 31, 1972: Receipt of nominations: 23 nominations on 18 separate tracts (later became 20 tracts). Comment: with

16 core holes on 20 tracts, the companies hardly had a clear picture of groundwater problems over all the nominated tracts, and for some tracts no groundwater data came from the informational core drilling (i.e., 20 tracts of 5120 acres = 160 square miles with 16 holes = one core hole per 10 square miles). 'The "tract nominations by industry were considered a direct indication of interest in particular areas" (III-IX-204). The "multiple nominations" (i.e., five at tract C-a with nearly identical boundaries) might imply that using a popularity poll may not merely reflect interest in the particular tract but might indicate a coordinated, cooperative, financial interest by associates.

6. Feb. - April, 1972: Evaluation of nominated tracts; final selection completed April 25, 1972. The EIS states that selection was to "allow consideration of the full range of resource development and environmental conditions and alternatives" (III-IX-211). However, the "screening process" to measure capability of tracts to meet program objections involved the consideration of seven economic criteria first, and then, as a last priority, came the environmental considerations (listed, III-IX-212). At the time of this screening process, not enough environmental information had been assembled to provide an adequate basis for judgment as to just what the impacts, local and regional, would be. For example, the state-contracted studies had only just begun on wildlife, environmental inventory, etc. Though a "full range of resource development and environmental conditions and alternatives" (see previous reference) was supposed to be considered, none of the five nominated tracts containing commercial amounts of

dawsonite or nahcolite was selected.

7. After April, 1972: Further environmental information was gathered by state environmental studies and private companies, and more core holes were drilled (14 more holes were applied for on public lands).

More information on these tracts has been obtained since they were selected. That information, not all of which is publicly available or included in the EIS, needs to be assembled now so that the tracts can be reevaluated more realistically by the public. For example, in the body of this review are many suggestions that the environmental problems at the two Colorado tracts could be overwhelming (see Sections 5-I-A and C of this review).

VI. CONCLUSIONS

1. The proposed oil shale leasing program is not based on a thorough analysis and review of the alternatives; it appears, rather, that a single program proposal was first formulated, and a cursory examination and rejection of alternatives was then written for the EIS. No serious consideration has been given by the Department to altering the program design.

2. The proposed program is not designed to meet the supposedly experimental purpose of leasing public lands at this time. The large scale of the proposed "prototype" operations belies any attempt to encourage technologies which might be less environmentally hazardous than those which are advanced now.

3. Alternatives such as a well-designed and diverse government experiment, a three-mineral industry, or private development on private land have not been analysed adequately (if at all) in the EIS, despite apparent potentials for less adverse impact and more beneficial return.

4. The present program involves significant risks to the public, the government and the participating companies which have not been analyzed in the EIS. As a consequence, alternatives whose risks might be fewer have not been examined in this light if at all.

5. At each phase of an oil shale program alternatives exist for mining, processing, waste control, environmental protection and evaluation of the program itself. Even with respect to these alternatives the EIS is sadly deficient and fails to give th reader the opportunity for comparative evaluation.

6. The tract selection process--an opportunity for considering alternatives within the framework of the proposed program--was carried out without due consideration of the many environmental and technical problems. Instead, tracts were selected which were apparently attractive to certain companies but which had severe ground water problems and unusual environmental values.

SECTION 5

A CRITIQUE BY DISCIPLINES

The material in this section constitutes a critical review of discussions in the EIS on relatively technical subjects. Experts in many disciplines have examined the EIS with respect to completeness and quality of data and the validity of the conclusions drawn therefrom. Reviewers have also referred to outside research and information to aid the analysis of the EIS and to help describe the potential environmental effects of proposed oil shale development.

A brief description of the region proposed for oil shale development follows.

The district comprising the geologic basins between the proposed oil shale mining sites in northeastern Utah, the Piceance Basin of northwestern Colorado and the sites in southwestern Wyoming comprise an area roughly the size and shape of the state of Connecticut. Within that area the 1970 population was only about 85,000 persons, with the majority of these persons living on the periphery of that area. In that region, there exists only one major road, which crosses the area from north to south. Even this road has a traffic flow of only 640 cars per day when it is open; that is, during the warm seasons. There are no east-west highways in the area, except those which follow the major waterways. A single paved road goes through the Piceance Basin along Piceance Creek from Rio Blanco northwest to the White River.

Within the three-state oil shale district there is considerable ecological diversity ranging from montane forest with 24 inches

of rainfall per year, to salt desert with less than 7 inches of rain per year. Many intervening cover types comprise very diverse vegetations and habitat, depending on slope, exposure, altitude. The country is notable for its rugged landscape. It supports 158 species of birds, 47 species of mammals, and a number of endangered species.

This is, in fact, a semi-primitive area in which human activity is largely confined to recreation activities, with a limited amount of cattle and sheep grazing and with some oil and gas production. The proposed oil shale program should be viewed in the context of this existing environment.

The focus of the material which follows is on the quality of the analysis provided by the Department of the Interior in the EIS.

Members of the review team found the EIS to be lacking in many critical respects despite its length. In particular, gaps in analysis led to misleading statements or implications, while certain potential impacts were barely discussed at all. These findings inevitably raised questions about the wisdom of the oil shale program itself and the Department of the Interior's interest in determining and weighing certain significant data on the immense human and natural impacts anticipated if oil shale leasing proceeds.

This section is divided into four subject areas--physical impacts, biological impacts, social considerations and certain off-site impacts. In turn, these areas are sub-divided to include discussions of the relevant disciplines.

I. PHYSICAL IMPACTS

A. Hydrology

1. Water needs

The needs for water in connection with the mining and processing of oil shale are not sufficiently described in the EIS. For example, throughout the statement it is said without substantiation that the needs amount to 16 to 22 cubic feet per second (cfs). (III-IV-57.) The total operation"for a 100,000 barrels per day (b/d) plant would consumptively use about 16.5 to 22.5 cfs or 12-18,000 acre-feet per year. Associated urban development could increase this to 13-20,000 acre-feet per year." (III-IV-57.) It is difficult to determine why this is such an imprecise estimate. Water needs both for industrial and associated urban development can be forecast more closely than that. One would suppose that the estimate of the fresh water need for urban development could be specified within 30%, whereas the water need for a particular size plant could be specified within about 10%. No explanation is given for the details of the source of information in the EIS dealing with water demand.

2. Water Quality Needed

Imprecision is found in the EIS analysis of the required water quality. In Figure IV-11, Vol. III, the demand and supply for water for a 100,000 barrel plant is expressed in cfs for the different parts of the operation. It is assumed by the report that "of 30 second feet pumped (second feet = cfs), 9 second feet will be of high quality and 21 second feet will be of low quality water."

(III-IV-63.) The origin of this assumption is not identified.

One presumes from reading the text that the high quality water produced would result from the initial dewatering operation, when water will be pumped from the upper part of the saturated zone. As shown by the Geological Survey water quality data, the water quality is poorer at deeper levels. The report fails to say that no mining can even begin until the upper part of the saturated zone has been dewatered. In other words, the groundwater table must be pulled down to the level of the mining operation, and during that dewatering, the pumped groundwater - whether of high or low quality - will have to be disposed of without use. The idea that the groundwater pumping operation is going to produce high quality water is not fully explained in the report. From the text one would have to assume, unless further information is presented, that the assertion is simply incorrect.

Furthermore, in the quantitative estimates of water used for various purposes (also in Vol. III, Fig. IV-11), the ranges of estimated water demanded and released are very large. For example, the excess of high quality water supposedly coming from the pumping operation is shown in that figure as 0 to 9 cfs. The low quality water, specifically shown in that figure to be derived from the pumping of mine water, is shown as 0 to 21 cfs. This range is excessive. The report does not explain under what conditions the mine is expected to produce 21 cfs of low quality water. Similarly, no description is given of the circumstances under which no low quality water would be produced from the mine. The same comment

can be made with regard to high quality water.

If one concurs with the broad assumption concerning how much of the pumped mine water is going to be high quality and how much low quality, the question arises -- is the water to be separated, to preserve the high quality?

It must be said, therefore, that the description of the demand and supply for water summarized in Figures IV-11 and IV-14 in Vol. III purports to be quantitative but has important deficiencies. It fails to provide the reader with a factual basis for estimating the water demand and the environmental impacts of disposing of the excess water.

These deficiencies are:

1) The range of water uses for all portions of the operation are so large that it would appear that essentially nothing is definitely known about the water needed or that to be produced.

2) Even assuming the ranges provided are generally acceptable, the report fails to make clear whether the range is concerned with time variations, or simply represents a lack of detailed knowledge for a particular period of time during the mining operation.

With regard to shale oil upgrading, Figure IV-11 indicates that 4 to 6 cfs of high quality water is required for the upgrading process. (This refers to a 100,000 b/d plant using water from a surface supply at tract C-a. The same amount would also be needed for an equal-sized plant elsewhere.) The discussion of the chemistry of the retorting process does not indicate why such a large amount of water would be required in the upgrading process. This is not

explained in the EIS. Four to six cfs, which is therefore 8 to 12 acre-feet per day, represents a very large volume of water for a 100,000 b/d production. These large water requirements for shale oil upgrading indicate that this water is actually going to be employed as part of the petroleum product. This impression is strengthened by following the flow diagram presented in the same Figure. The diagram shows that 4 to 6 cfs of high quality water goes into the shale oil upgrading, and 1.1 to 0.3 cfs of low quality water is discharged from the same operation. The minimum amount of water needed in the shale oil upgrading would be approximately 3 cfs, and the maximum would be almost 6 cfs. This would mean that approximately 6 to 12 acre-feet per day would be consumptively used in the shale oil upgrading. If this is so, then the water used is 47 to 94 % by volume of the 100,000 b/d petroleum production. These values should have been explained in some detail in the report.

The estimates of demands and discharges of water in the EIS thus carry the appearance of being quantitative when in fact they raise more questions than they answer.

3. The Disposal of Excess Water

Though the prototype operation may well have an adequate supply of fresh water, the disposal of saline waste water will be a major problem even for the trial operation. Numerous cross-checks in the EIS indicate that 25,000 acre-feet per year, but possibly as high as 35,000 acre-feet per year, is a minimum estimate of the waste water produced by a 250,000 b/d plant. Nearly all of

this amount comes from the disposal of mine water. Hence, it will have a very high concentration of dissolved solids. (If one assumes a salt concentration of 10,000 milligrams per liter, a total of 25,000 acre-feet per year of waste water will carry approximately 350,000 tons of dissolved solids per year, or 10% of the total carried by the Colorado in 1957.* This is a rough calculation which can be improved upon. However, the point to be made is that the impact would be considerable. The EIS does not discuss this. Instead, the authors blandly state that the water could be purified. In fact, desalinization has never been accomplished on such a scale over an extended period of time except in a few places in the world. (See next section on the Colorado River.)

The excess waters to be produced by the processing are shown in the flow diagram of the report to vary from 0 to 30 cfs for only a 100,000 b/d plant at tract C-a. (IV-IV-65.) Thirty cfs, which would be the maximum, amounts to 60 acre-feet per day. By any assumption of the total area of spent shale storage, it is illogical to assume that this amount of water could be utilized by infiltration and evaporation on the spent shale area. No estimate in quantitative terms is given in the EIS for the maximum amount of excess poor quality water which would need to be disposed of downstream from the spent shale storage area.

The report suggests the need of a storage reservoir, presumably of small size, downstream from the spent shale storage area which would prevent this excess water from getting into the Colorado River system. A computation of the size of the reservoir needed

*USGS Prof. Paper 441.

indicates that the reservoir of such a size is far greater than that explained in the EIS.*

At tract C-b, on the other hand, the problems with regard to excess water from dewatering and mine pumping are worse: "That is, the quality of water to be pumped will be greater and more of the water will be saline" (III-IV-78) (Salinity figures are not stated). The report predicts that for a plant capacity of 50,000 b/d, or half the size of the previous model for tract C-a, pumping of excess waters will peak at 30 cfs, of which 12 cfs is of high quality and 28 cfs of low. (Figure IV-15 in Vol. III). This indicates that the maximum excess waters will be 2.7 times larger by volume and will be of more saline character at tract C-b than at C-a.

4. Demineralization

Demineralization is a comparable problem. With regard to the excess mine water, admittedly of low quality, the report states:

> Desalting technology is well established for waste waters of the type that may need to be treated. Gas may be available from the surface retorts, which suggests the possibility of a thermal process such as distillation being used. Using a distillation processes, water recovery up to 98% can be obtained. The distilled water would be approximately 10 ppm dissolved solids, or less, and could be blended with additional saline water to obtain a product suitable for release to surface streams. (I-III-61.)

This brief statement is unsatisfactory in many respects. Desalting technology is indeed available, but is used in practice in only a few places in the world. The cost, in capital expenditure for the plant, in power requirements, and in the additional expense of

*The excess of low quality water, 25 cfs, produced in a year would fill a reservoir of 1600 acres 10 feet deep.

brine disposal, could offset the benefits hoped for in the oil shale operation. The EIS's assurance that the availability of desalting technology could indeed be applied to the oil shale development in a practical and economical sense is unsubstantiated in the report.

5. Elimination of Salty Waste Water by Injection Wells

A long discussion is included in the EIS regarding the possibility of disposing of excess low quality water in injection wells (III-IV). No mention is made in the report that injection wells have been tried experimentally in various parts of the United States and only in exceptional cases have been found to be satisfactory. For example, the injection wells under study by the Geological Survey have been plagued with the plugging of pore space in the aquifer due to the deposition of chemical constituents from the injected groundwater. Since the water to be disposed of in the oil shale operation is of low quality (i.e. high in chemical constituents), the EIS should have discussed in considerable detail these actual experiences in the use of injection wells. Similar difficulties could well be encountered in Colorado.

In addition, there was an incomplete discussion of the relationship of water injection into well systems and the need for continued dewatering of the oil shale mine area. Water to be disposed of would presumably have to be pumped a considerable distance away from the mine area to be distributed into injection wells in order to separate it physically from the vicinity of the mine

itself. Again, a lack of factual material describing the physical process of injection and the economics of injection wells is filled by unsubstantiated assertions in the EIS.

6. Presentation of Data

With regard to detailing the demands for water and the problems of excess water disposal, the EIS is unclear. For example, the authors of the EIS jump from discussions of operations producing 100,000 b/d to examples that treat the production of a 1 million b/d rate. An example of this problem appears in the comparison of Figure IV-11 in Vol. III, where the demand and supply figures for water concern a 100,000 b/d operation, to paragraph 2, page III-63 where the estimates concern a 1 million b/d industry. Such changes in references that describe hydrologic considerations make the EIS extremely difficult to read. In addition, there are such large separations in factual material supporting the assertions through the several volumes that the reader is left in serious confusion.

7. Completeness of Discussion/Public Interest

Most important points concerning hydrological aspects of oil shale development were brought up in more or less detail by letters commenting on the draft EIS (Vol. V), or in the public testimony (Vol. VI).

With regard to water supply, for example, and its relation to other water demands in the state of Colorado, important points were brought out in full detail by the Colorado Water Conservation District.

(page 73, Grand Junction, Colorado transcript section, Vol. VI). Considering the detail in which Mr. Fischer of that organization explained the relationship between the oil shale development and other Colorado uses for totally unused water, one would have hoped that the final EIS would have offered as complete a discussion as did that witness. Quite the contrary is true. Similarly, the EIS neglected many other aspects of water supply about which various letters and testimony brought up questions or made factual statement pertinent to and appropriate for consideration by the Department of the Interior.

8. Unreported Data

It must be asked why the EIS did not provide a coherent summary of the findings made by the Geological Survey's investigation of the groundwater in the oil shale area. These data were clearly employed to some degree, but, except for brief references in connection with injection wells, no statement in the EIS deals with the findings from the groundwater investigation made by the Survey (The basic data for a large number of wells are in the public domain, even though the final report is not yet published. See Section 6,"State Input.") Water quantity and quality is shown by Survey analysis on wells in the basin. The geologic information with which the water data might be interpreted is central to many of the problems being discussed under water demand and water disposal. It is incomprehensible that a final EIS from the Department of the Interior should fail to present in considerable detail the results of the investigation by a fact-finding agency

within that Department.

Quite apart from the basic data already in the public domain having to do with quality and quantity of groundwater in the oil shale area, the Geological Survey is presumably working now on an analysis of these data. It is well known that groundwater studies made by the Survey go far beyond the mere presentation of the basic well observations themselves. Such interpretive data must have been available to other members of the Department of Interior and could certainly have been made part of the EIS. Given the extensive direct quotation dealing with water matters contained in Vols. V and VI, it would be only logical to expect the authors to present somewhere in the EIS a summary prepared by the Geological Survey dealing with water facts and their interpretation.

It is well known that the Survey has been working on various aspects of water demand and water use in the Colorado basin for many years. To prepare an EIS dealing with such a massive proposal as oil shale development without including a summary of these data and interpretation (prepared by the U.S.G.S) does not seem to be in the public interest. As it is, an interpretive appraisal of the water budget, such as one that could have been provided by that agency, is lacking in the report.

9. Salt Loading of Colorado River by Spent Shale Leachates

The EIS makes no attempt to quantify the salt loading of the Colorado River that may result from leaching of the water-soluble material contained in spent shale residues. This is a serious omission in view of the large quantities of leachable materials

that would be stored in the spent shale dumps.

Admittedly, the actual potential for mobilization and movement of spent shale salts into the Colorado River cannot be accurately predicted without knowledge of the hydrologic properties of spent shale, the method of spent shale disposal (surface dumping, underground mine backfilling, or creation of in situ underground dumps) or the hydrometeorology and hydrogeology of disposal sites. This knowledge is not specifically available for development tracts considered in the leasing program.

Some insight into the leaching hazard can be obtained, however, by using an indirect approach. This discussion is intended to demonstrate the type of information the EIS could have provided. The calculation done here estimates the salinity loading of the Colorado River at Hoover Dam that would result under varying levels of salt production and control.

For discussion purposes, the annual production rate of leachable salts contained in spent shale is estimated to be 5.18 tons per barrel of daily shale oil capacity. This value has been derived by solving the equation below and by using the assumptions explained in the accompanying footnotes:

$$S = B \times (1/GxE) \times (1-W) \times C \times Y$$

Where: S = production of soluble salts in spent shale (tons/year/barrel)

B = number of gallons in U.S. barrels of oil (42)

G = grade of fine shale (30 gallons/ton)[1]

1. Average shale grade generally considered by Oil Shale Task Force; e.g., EIS I, Table I-5, p. I-23.

E = upgraded oil recovery ratio (90%-volume)[2]

W = weight loss of mine shale during processing (20%-weight)[3]

C = soluble salts contained in spent shale (0.0114 tons/ton)[4]

Y = number of calendar days per year (365).

The total annual output of spent shale salts by a 50,000 b/d plant would be 5.18 tons times 50,000 barrels or 259,000 tons. The annual output from a one million b/d industry would be 20 times larger, or 5,180,000 tons.

Data relevant to the analysis are summarized in Table 1 (following). Columns 1 and 2 of the table set up a hypothetical production schedule for oil shale development. The development schedule through 1985 is identical to that proposed in the EIS (I, Table III-2, p. III-9); after 1985 the industry is assumed to stabilize at 1 million barrels per day, though the EIS projects development to higher levels (for example, I-III-68). Column 3 shows the cumulative output of leachable salts that would be contained in the spent shale produced. Columns 4 and 5 list the incremental salinity concentrations in the Colorado River at Hoover Dam that would result if leaching were controlled at the 99 and 99.9% level, or, alternatively, if 1 or .1% of the accumulated salts were mobilized and carried downstream. Columns 6 and 7 list the annual penalty cost to the regional economy below Hoover Dam associated with the incremental salt loadings. "Penalty cost" would be financial

2. Approximate average of extreme values cited in EIS I, footnote to Table 5, p. 123.
3. Approximate weight loss in TOSCO II retorting system (Spec. Comm. of Governor's Oil Shale Advisory Committee report, 1971, p. 89).
4. Conversion of 1,120 Mg/100 grams value for TOSCO spent shale (EIS I-III-84).

TABLE 1

Hypothetical Salt Loading of Colorado River and Hoover Dam by Spent Shale Leachate

Year	Cumulative Shale Oil Capacity (Barrels/day).	Cumulative Amount of Spent Shale Salts (tons)[A].	Incremental Salt Concentration (mg/l) at control level of:[B]		Annual Penalty Cost ($) at control level of:[C]	
			99%	99.9%	99%	99.9%
1976	50,000	259,000	<1	<1	<67,000	<67,000
1977	50,000	518,000				
1978	150,000	1,295,000				
1979	250,000	2,590,000				
1980	300,000	4,144,000	3	<1	201,000	<67,000
1981	400,000	6,216,000				
1982	550,000	9,065,000				
1983	700,000	12,691,000				
1984	850,000	17,094,000				
1985	1,000,000	22,274,000	18	<2	1,206,000	<134,000
1990	1,000,000	48,174,000	40	4	2,680,000	268,000
1995	1,000,000	74,074,000	61	6	4,087,000	402,000
1999	1,000,000	94,794,000	79	8	5,293,000	536,000

[A]Based on 5.18 tons per barrel of daily shale oil capacity.

[B]Based on projected salinity concentration at Hoover Dam of 876 Mg/l in the year 1980(EPA Summ. Rep., 1971 Fig. 2) Calculated from the formula: $\Delta C = [k(P+A)/Q] - C_i$ where ΔC = incremental salinity concentration at Hoover Dam(Mg/l), k=conversion constant representing salinity concentration of 1 ton of salt/acre-foot of water(735), P=projected salt load at Hoover Dam without oil shale development(10,512,000 tons), A=salt load added by oil shale development(from column 3 in above table), Q=projected water discharge at Hoover Dam, neglecting any new depletions by oil shale development(8,823,000 acre-feet), and Ci= projected salinity concentration at Hoover Dam without oil shale development(876 Mg/l).

[C]Penalty cost of $67,000 per unit of salinity increase (EPA, 1971).

burden to downstream water users due to increased salinity -- for example, loss of irrigation water or reduction of crop output resulting from salinity.

The analysis is simplified in that no allowance is made for progressive leaching of the extractable salts. Rather, the salts are assumed to accumulate and leach out only in the target years specified. Refinement of the analysis seems unwarranted here in view of uncertainty regarding shale grade, retorting procedure, and other factors. For example, use of saline mine drainage in dust control and compaction of spent shale (I-III-57) would contribute additional salt to the dumps. One acre-foot of only moderately saline water, approximately 2,000 Mg/l, would add 0.00136 times 2,000, or 2.72 tons of salt to the river. This could total 11,968 tons of salt per year for a 50,000 b/d plant. (Based on maximum consumptive use of 4,400 acre-feet, as cited in the EIS, I, Table III-5, p. III-34.)

All salinity impacts listed in Table 1 refer to the 1980 base period and have been derived using stream flow and economic projections made by the U.S. Environmental Protection Agency (1971).[5]

Despite imperfections in the analysis, it appears obvious that leaching of shale dumps must be controlled at efficiencies greater than 99%. Leaching of only 1% of the salt potential accumulated by 1985 would increase the salinity level at Hoover Dam by approximately 18 mg/l. This would be supplemental to the already considerable

5. EPA, 1971, "The Mineral Quality Problems in the Colorado River Basin," Washington, D.C. Government Printing Office, 5 vols.

salt concentrations in the River, which the Department's Oil Shale Task Force estimates to be 10 to 15 Mg/l for an industry size of 1 million b/d.[6]

Salinity impacts at 99.9 percent control might be tolerable through the period of analysis considered in the accompanying table if no reference is made to the ionic composition of the salt load. Unfortunately, the leachate from shale dumps would contain appreciable amounts of sodium.[7] High sodium content in irrigation waters may produce harmful effects in most soils (EPA, 1971). No attempt has been made here to evaluate the sodium risk to irrigation water users below Hoover Dam.

Further investigation is needed to determine the level of control that can be reasonably expected. Salts may be leached by overland flow (including solution of salts contained in eroded sediments) by percolate moving downward from the surface, by groundwaters moving horizontally through the dumps and by slurry drainage waters.

10. Comments Concerning Spent Shale Piles

In conclusion, the spent shale itself holds the greatest potential for salt poisoning of the Colorado River. Based on the analysis presented here, the spent shale produced annually will contain an average of 3 million tons of soluble salts by 1981. Since this quantity is equal to approximately 70% of the present annual

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6. The Task Force estimate of load cannot be verified because no data are given for stream flow and salt load at Hoover Dam without oil shale development. The projected impact is unrealistic, however, because 1970 conditions are used, whereas the industry would not reach 1 million b/d until 1985.
7. Schmehl, W.R. and B.D. McCaslin, "Some properties of spent oil-shale significant to plant growth," Fort Collins, Colo. Agr. Expt. Sta. Sci. Series Paper No. 1496, 1972, 26 pp.

dissolved salt load of the Colorado River, it is readily apparent that the spent shale must be contained on site. It must be completely isolated from the natural drainages both during and long after the mining is completed.

The EIS does not analyze the problem fully enough to indicate either the magnitude of the problem or the ways in which it might be solved. The statement that containment can be effectively accomplished by compaction of the salty spent shale heaps disposed of in the high canyons above the Colorado River (I-I-26) is based on a small scale test by TOSCO (The Oil Shale Corporation), and its success depends partly on successful revegetation and cover restoration on the shale heaps. Also necessary will be construction of dams both upstream and downstream from the shale piles and repumping of leachate back into the shale piles. A serious unanswered question is whether these dams and the necessary pumping will be maintained in the far future after this prototype program is complete. The EIS, including provisions in the lease, does not account for this need.

The impact of flash floods (which are considered, I-III-78 through 90) and other mass wasting processes (not treated) are a concern. Though slope failure, landslides, and sheet wash during flash floods are probable occurrences, debris flows are an even greater risk. The walls of Parachute Creek Canyon, for example, are coated with debris flows, attesting to the importance of this phenomenon in the area. Intense thunderstorms, steep slopes and an abundance of poorly consolidated shale combine to form ideal ingredients for debris flows. Should a portion of the processed shale become well-moistened, as no doubt will occur, debris flows

will result, even on moderate slopes. Such a flow would move a considerable distance, perhaps several miles, at very high speed. Natural dewatering of the flow after it stopped would contribute highly saline water into the natural drainage channels, hence into the Colorado River. In addition, subsequent leaching of debris would be very difficult and expensive to control.

11. Conclusions

The description of water demand and supply summarized in the EIS purports to be quantitative, but has important deficiencies. It therefore fails to provide the reader with a factual basis for estimating the water demands and the environmental impact of disposing of the excess saline water.

The major deficiencies:

1. The ranges of estimated water usage are so large that it appears that essentially nothing is known about the water needed by the operation or to be produced from the mines.

2. Even assuming the ranges provided are generally acceptable, the EIS fails to make clear whether these imprecise estimates are due to time variations or from a lack of information for a particular phase of the operation. Thus, the estimated demands and discharges of water appear to be quantitative when in fact they are far from definitive.

3. Some aspects of the water data, i.e. unallocated water in the Colorado River, were taken up by witnesses at the hearings more adequately than they were treated in the EIS.

4. A broad interpretive discussion of the available water resource at each site and in the basins concerned, and the relation of these

water quantities to the proposed uses and potential environmental impact of these uses was not given. This could have been provided by the U.S.G.S. in the EIS.

5. The EIS indicates that the potential amount of excess water from mining and dewatering Colorado tracts C-a and C-b will be a threat to tributaries and the Colorado River because of large volumes of saline water. With oil shale plants* on both Colorado tracts, these waste waters might reach a maximum flow of 110 cfs. The EIS does not discuss the potential impact of waste waters on the Colorado River, though the impact could be considerable.

6. Available groundwater data from near the Colorado tracts, in addition to the EIS projections of maximum dewatering and mine pumping for tracts C-a and C-b, indicate that these particular tracts should be reconsidered. The groundwater problems are particularly excessive at C-b. Some other rich oil-shale sites in the Piceance Basin appear to present fewer groundwater problems. Hydrologic data would indicate reevaluation is needed for all tracts nominated in Colorado.

7. The environmental impact of spent shale piles and their possible contribution by leaching and mass wasting of soluble salts to the Colorado River is not evaluated in the EIS. Instead, it is assumed in the EIS that the compaction of spent shale in canyon bottoms will provide no leachate to the tributaries. A calculation of the magnitude of the potential problems shows that

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*of 100,000 b/d capacity

even if 1% of the salt in the spent shale piles were to escape into the tributaries and into the Colorado River the damage would be severe to downstream users--a $5,293,000 burden by 1999.

8. The alternative to returning most spent shale tailings to mines was not properly evaluated in the EIS; reburial of these tailings in the same levels from which they came, to the maximum extent possible, would create far less threat of leaching than would outdoor storage and could be required by the lease.

B. Air

1. Introduction

Although the Final EIS appears to be reasonably accurate concerning sources and quantities of air pollutants that would result from oil shale development, its optimism as to the ability of the industry to control air pollution within acceptable limits does not seem warranted.

The EIS concludes that, even though many expected pollutants cannot now be controlled adequately, the air quality degradation resulting from oil shale development will be within applicable limits (I-III-147).

The existence of "no significant degradation" guidelines to be established by the Environmental Protection Agency cast particular doubt on the potential ability of an oil shale industry to fall within the law. In one place the authors predict "a decline in ambient air quality" (I-III-170); in another, they state:

> Any final plan(s) promulgated by EPA with respect to the definition and prevention of "significant deterioration" would be incorporated into the proposed prototype oil shale lease program. . . . (I-III-118)

And in another: "It is anticipated that all applicable ambient air quality standards can be met. . . ." (I-III-170)

Optimism on the subject of air quality has not been substantiated by information in the EIS or elsewhere.

This discussion will be concerned exclusively with the possible impact of prototype oil shale development as outlined in the EIS on air quality in the various air basins involved. It will reflect agreement with certain portions of the statement, disagreement with others and will pose a series of questions which remain unanswered. It will also consider the impact on air quality of various technological alternatives to the proposed leasing program.

2. Impacts During Development Stages

a. Pre-construction: The major air quality impacts will be dust arising from the construction of roads and emissions from construction vehicles (I-III-121). Although various control measures such as water spraying will be employed, these will probably not be very successful and a dust problem will prevail. Lacking wind data (directions and velocity in a frequency distribution) no estimate may be made of the dispersion of this dust. A possibility exists for the formation of photochemical smog from the nitrogen oxides and hydrocarbons emitted by the vehicles. The use of diesel equipment will moderate this effect. The pre-construction stage will be marked by an unsightly and unpleasant atmosphere but not one involving major air pollution problems.

A "baseline" monitoring network must be set up for at least eleven months to assess air quality prior to oil shale development (III-V-51). Four locations are required, one at the expected maximum pollutant level. This proposed monitoring program will not supply the necessary baseline data because a one-year study does not represent average conditions and four monitoring stations will not provide enough data. In addition, the Mining Supervisor is given an exceptionally free hand in determining the pollutants to be monitored (III-V-52).

b. Early Construction Phase: This period will also be characterized by the dust hazard described above, with the addition of waste from housing. It is not known what heating fuels will be used. Natural gas is desirable but in very short supply; fuel oil and coal present emission problems. The increased use of gasoline-fueled private vehicles may cause more photochemical smog, though public transportation could be developed. Lack of sufficient climatological data prevents accurate predictions (III-specific tract descriptions). If open pit mining is used, there will be further emissions of dust. Particle size distribution has not been

estimated; for example, what particulate concentrations are estimated in the respiratory range?

c. Late Construction Phase: We include start-up in this category. The problem of emissions from residential sources will now become acute. It is not known what transportation system will be used; will workers use their own vehicles or will mass transportation be provided? This will have a bearing on the photochemical smog potential. The source(s) of electrical power are also not known; emissions of particulates, sulfur dioxide and nitrogen oxides could result. By Colorado law, waste cannot be incinerated. What means of waste disposal will be utilized? Dust produced by the mining and crushing of shale may be within the allowed state and federal limits (I-III-123) for emission rates-process rates standards, but with the lack of dispersion data it is questionable whether ambient air quality standards can be met. How will the shale oil be transported--by truck, rail, or pipeline? All could cause air pollution.

During the start-up period, failures in design and equipment will probably occur. What precautions will be taken to minimize air pollution resulting from such failures? Will there be a responsive emergency pollution monitoring network requiring shutdown and possibly evacuation? How will the pollution control equipment be tested? If it is unsatisfactory will it be replaced before full scale operation? What will be the response of operations to the pollution monitoring system?

d. Operation (post-construction and mining): The mechanisms and requirements for monitoring and evaluation of air pollution need to be determined. Will variances for air pollution be allowed? When? Air pollution control technology is not completely understood and may require changes. If off-the-shelf equipment does not work, do we make changes, or will variances be granted? It is admitted in the EIS

that in the operation stage we will have air quality degradation (I-III-170). There are significant deficiencies in the air pollution monitoring network stipulated in the lease (III-V-51). Too much authority is vested in the Mining Supervisor: he may elect to shorten the period of monitoring after operations have begun (III-V-51); monitoring of all pollutants other than sulfur dioxide, hydrogen sulfide and suspended particulates is subject to his judgment (III-V-52).

The environmental impact on air quality of a full operation stage would include increases in sulfur dioxide content, increased concentration of nitrogen oxides, carbon monoxide, hydrocarbons, etc. It is indicated that production of carcinogens will be minimal in the spent shale (IV-III-42), but some technologies would burn spent shale as coke to heat retorts. No measurements on these emissions are given. The question of synergism is raised, discussed and dismissed because of lack of information (IV-III-40). These factors could be important aspects of air pollution as a result of an oil shale industry.

A simple mathematical model has been utilized to predict ground level concentrations as a function of atmospheric conditions and distance from the emitting stack (I-III-136). This is the well-known Turner-Gaussian plume model that ignores fallout of particulates, ground absorption and reflection from an inversion (although this last factor can be included if so desired). The model is not applicable, with the standard deviations given in the literature, to valley terrain. If it be used, the model must be validated; this can be accomplished using plume simulants such as sulfur hexafluoride. Validation must be done at the plant sites. There has been no attempt to develop air pollution predictions specific to the proposed lease tracts. Nor is there yet an evaluation of the Piceance Basin as an air basin relative to the rest of the state. Use of the model will require the compilation of wind roses and inversion heights. This information must be obtained at the sites and

not at a distant weather station.

3. Technical Appraisal and Conclusions

The authors of the EIS admit that air quality in the various basins will be degraded (I-III-170). It is further pointed out that this may be in violation of the "no degradation" policy suggested by a recent Supreme Court decision (I-III-117). It has not been pointed out that such degradation is explicitly forbidden by an existing air pollution control regulation of the Colorado Air Pollution Control Commission (Vol. V-19-3).

In order to judge this matter, we need a good monitoring program with publicly available records so that the changes and the baseline conditions are well known. The monitoring program, however, is inadequate with respect to: a) the authority vested in the Mining Supervisor to determine the monitoring period and the pollutants, other than sulfur dioxide, hydrogen sulfide and particulates, which are to be monitored, and b) the lack of a precisely stated feedback mechanism between monitoring results and operations. The length of the "baseline" monitoring program is too short to provide the necessary baseline data; fluctuations observed over a one-year study may mask actual changes occurring after operations.

The Gaussian plume models used to estimate pollution burdens must a) use data obtained at the prospective emission sites and b) be validated possibly by the use of a tracer at these sites. This has not been done.

The specific pollution control technology to be utilized is not discussed. What technology will be used? How will its success be evaluated? Will it be replaced if unsatisfactory? What about "upset" conditions? Will backups be available?

The question of photochemical smog formation from hydrocarbons and nitrogen oxides emitted from process operations and use of gasoline fueled vehicles at

high elevations has not been properly considered. Air quality problems in Denver indicate the importance of the altitude factor.

Attention must be paid to possible pollution episodes as well as long-term averages. No data are available for this evaluation. What is the frequency of inversions (how many successive days); what about the duration of stagnant high pressure systems?

The question of synergism has been raised and remains unanswered. Laboratory studies would help here. Synergism between particulates and sulfur and nitrogen oxides is known. There is no discussion of and no evidence of study of particulate particle size distributions and the quantity of particulate matter in the respirable range in the EIS, nor is there evidence that this problem will be examined further. (Small particles--usually not controlled by emission control devices--are particularly harmful to lungs.) What about trace metals and carcinogens in the atmospheric particulates? These may be highly toxic. To date no evidence is given in the EIS statements concerning carcinogens, though the occurrence of carcinogens during pyrolysis is well established.

Much more must be done to properly appraise the impact of the proposed oil shale program on regional and local air quality. In addition, more should be written into the analysis and lease to deal with minimizing air pollution effects during operation.

4. Mining and Processing

a. Strip Mining and Retorting: The air pollution potential for this alternative arises from dust from the mining activities and emissions from the retorting operation. This latter would be similar to that observed in many industrial operations and for which abatement technology is most advanced. (See

I-I-7 for a discussion of mining technology.) Little attention has been paid to dust control in strip (surface) mining operations, though extensive progress in dust control has resulted from operation of underground facilities. From underground mines, therefore, one would anticipate little hazard from dust. Retorting processes (discussed in I-I-11) are amenable to present air pollution control technology. The major difficulty seems to be with sulfur dioxide control; this may be handled by wet scrubbers. No control of nitrogen oxides is currently available. One would conclude from present knowledge that this combination could be dealt with reasonably well, except for potential cumulative effects from large numbers of emission sources.

b. Underground Mining and Retorting: This is the most advanced combination technologically at the present time. Little dust hazard in the mining (see previous paragraph) is anticipated; air pollution from crushing can be controlled.

c. In Situ Processing: It is stated in the EIS that ". . . the technology is not yet developed to the extent that prediction of either technical or economic success is warranted." (I-I-34). It is difficult to predict air pollution effects, except those of supporting facilities, especially roads, where dust would be a problem. In general, air pollution effects of in situ processing would probably be least of the alternatives. Effects would depend on what fuel is used to heat the plumbing for an in situ operation.

d. Multi-purpose Processing: One company's plan (Vol. V-74) is an example of multi-purpose processing. This process, discussed in the statement (I-I-30), uses the dawsonite and nahcolite in deep oil shale deposits. The retorted shale after oil recovery would be roasted to remove carbonaceous residue and leached to remove soda ash and sodium aluminate. The latter may be treated with soda ash to produce aluminum oxide for metallurgical use or treated for use

in water purification processes. The advantages of this process include: a) production of nahcolite (a type of sodium bicarbonate) that would be useful in sulfur dioxide abatement technology, b) production of aluminum oxide for conversion into aluminum or an aluminum compound for water treatment, and c) a reduction in volume of spent shale which could be returned to the mine for disposal. With respect to a) it is pointed out that a plant producing 35,000 barrels per day of upgraded shale oil would yield 15% of the U.S. projected 1980 needs for soda ash; "a limit of two or three plants utilizing the nahcolitic/dawsonitic shale would be expected unless new major markets are developed" (I-I-33). The use of soda ash in sulfur removal would transfer the problem of pollution abatement from the air to the water field, how does one dispose of large quantities of aqueous or solid sodium sulfate resulting from the sulfur dioxide pickup? One company shown that in combination with aluminum trihydrate the products sodium aluminate and aluminum sulfate can be used as an effective agent in cleaning waste waters. A market for these uses is at hand. This process has been tested at the bench level only, but it holds ecological and economic potential.

5. Comments

This analysis applies to the prototype program. If this program proceeds and is sucessful the momentum gained might cause vastly increased production and a cumulative effect on air pollution that has not been properly assessed. Such a situation might create political pressure resulting in the granting of variances (permissible under Colorado law on economic grounds).

6. Conclusions

a. The EIS admits that if the oil shale program is implemented significant degradation of air quality will occur (I-III-118). (For further discussion of

legal conflicts, see section 8 of this review.)

b. Evaluation of air pollution burdens by means of a simplified Gaussian plume model is inadequate. The Gaussian model must be applied to those conditions existing at the emission sites and should be validated by use of tracers. This has not been done.

c. There is no evidence indicating that ambient air standards can be met by the proposed oil shale development. It is admitted that SO_2 standards cannot be met (I-III-170). It is quite likely that all or most emission (as opposed to ambient) standards can be met, however.

d. The monitoring system proposed is not adequate and places authority in the hands of the Mining Supervisor whose expertise lies in other areas.

e. Little attention has been paid to possible pollution episodes. Similarly, photochemical smog formation has not been analyzed.

f. An evaluation of the regional air basins involved in the six selected tracts is needed to judge the susceptibility of the drainage to inversions. For example, an air basin map of Colorado (not now available to the public) created by one private industry indicates that the Meeker area is one of the worst air basins in the state in this regard. Both tract C-a and C-b are in this air drainage.

C. Geology

1. Geologic problems

Three major geologic problems of oil shale development are taken up in other sections of this review:

a. Comparative environmental problems resulting from various mining methods and technologies on selected tracts and at other types of sites. This topic is explored under Program alternatives, Section 4 of this review.

b. Swelling of oil shale tailings. After crushing and returning of oil shale rock the resulting tailings--of powdery consistency--are about 1.5 times larger than the original rock. Hence it is difficult to put all or even most of the tailings back into the mine. An exception occurs at certain sites where, in addition to oil shale, other commercial minerals occur (e.g., dawsonite, nacholite). At such sites these minerals can be commercially extracted for marketing, thereby reducing the volume of the tailings so they could be returned to the mine. (See "Program alternatives: a three mineral industry," Section 4 of this review.)

c. Salinity of sediments and groundwater. When salts present are not of commercial value, as in tracts U-a, W-a, W-b, C-a, and C-b, problems of excessive salinity in tailings and groundwater are serious environmental hazards, particularily with respect to waste water disposal and spent shale leaching. (See Section 5-I-A of this review, on Hydrology.)

Also of interest in regard to water is the following:

d. In the Hydrology section of this review we indicated that, in treating the problems of excess waste ground water, a maximum anticipated flow from mining operations at tracts C-a and C-b would be 110 cubic feet/sec for the two oil shale plants, with each producing 100,000 barrels/day. This amount would equal 219 acre-

feet of water per day for the operation, equal to 78,855 acre-feet per year, or 70 million gallons of water per day. (About 79,000 acre-feet of potable water per year is enough to supply a community of 395,000 at the national average of 180 gallons per person per day.)

We calculate that the volume of excess water produced would be 8.4 times larger than the volume of the shale oil produced. The environmental problems of getting rid of such volumes of water at these two sites are thus considerable, and are inadequately dealt with in the EIS.

2. Additional considerations

In addition, we note that the EIS is deficient in its consideration of two areas which warrant special attention: problems associated with trace elements in oil shale, and the overall value of the mineral resources at the sites.

a. Trace elements in oil shale. The release of trace amounts of toxic elements such as mercury, cadmium, and lead into the environment is one of the most difficult and potentially significant problems we face in developing new mineral resources. Although the EIS addresses this problem in terms of water quality (I-III-98, 99) it does so in vague terms, admitting that the long term impact is unknown. This raises four areas of concern:

1) Release of these materials into water and subsequant resultant degradation of aquatic life, soils irrigated by that water, nearby animal life, and human health. Although the report suggests a minor, short-term impact, there is not enough data presented to support that conclusion. Some of the data (I-II-229) show very high flouride levels in surface and groundwaters in the area.

2) Release of volatile trace metals from the retort stack gases and their subsequent impact on plant and animal life and human health. The main elements of

concern here are probably fluorine and mercury, which can occur at very high levels in the Green River oil shale, as shown in Cook, E. W., 1973, Chemical Geology, Vol. II, pp. 321-324, and Cadigan, R. A., 1970, "Mercury in Sedimentary Rocks of the Colorado Plateau Region," U.S.G.S. Professional Paper 713: 17.

3) Buildup in plants growing on spent shale of heavy metals to levels toxic to the plants or to the animals eating them. This food chain concentration or biological magnification, a widespread phenomenon in natural ecosystems, has apparently not been investigated in any depth with regard to this proposed project and could cause severe problems for deer and grazing livestock, as well as for a variety of predators native to the area.

4) Release of toxic substances upon burning of oil removed from the shale. This will take place at times and locations remote from the mining itself.

A complete evaluation of the biogeochemical pathways of potentially toxic trace elements or compounds, including extensive sampling of waters, plants, ash, oil, spent shale, and stack gases is necessary before the true costs of the proposed oil shale development in terms of control procedures, damage to nature, agriculture, and human health can be properly understood. The EIS indicates that such an analysis was not even attempted by the Interior Department.

b. Value of the mineral resources affected by the project. In order for the public, the federal, state, and local officials responsible, and the potential lessees all to understand the policy alternatives and the trade-offs implicit in the leasing of public oil shale lands, the EIS should present a lucid and detailed account of the total amount, quality, and value of all resources to be leased or otherwise committed, sold, or depleted by the proposed project.

The EIS describes the "Irreversible and Irretrievable Commitment of Resources" (III-VII-1 through 9) that will result from leasing the six tracts. The

discussion of minerals in this section is confined to those which would actually be mined and used. It does not include minerals mined but not economically used, nor those mined which cannot be recovered because they will be destroyed in the mining process (e.g., sodium and aluminum-bearing minerals) or because the beds in which they lie must remain as support. The resources to be mined are vaquely described-- "some 3-to-5 billion barrels of shale oil and possibly nahcolite, dawsonite and halite minerals." (III-VII-2)

The EIS purports to present a detailed assessment of the characteristics of the tracts nominated for oil shale leasing (III-IX-36 through 236). However, nowhere in this section is a detailed description of the mineral resources contained in these tracts set forth on the basis of quality, quantity, and value. For example, the description of the mineral resources of Colorado tract C-a (III-IX-67) is confined to oil shale of extremely high quality--30 gallons per ton in deposits thicker than 10 feet. No discussion is addressed to the total oil shale resource; the associated minerals are again vaguely described -- "Nahcolite that is present probably occurs in pods. About 500 feet of section contains sawsonite in varying amounts."

On the basis of the EIS, the amount, quality, and value of these public oil shale and mineral resources which the Department proposes to expend all remain uncertain or undefined. These are fundamental concerns and should be fully and publicly set forth in advance of any action making large and irreversible commitments of these public resources.

II. BIOLOGICAL IMPACTS

A. Revegetation

1. Introduction

A million barrel per day oil shale industry is estimated to create land disturbance amounting to 80,000 acres over a period of 30 years. (I-III-23). According to the EIS, efforts will be made to revegetate some of this disturbed land, particularly that directly associated with the mining, processing and tailings disposal operations. But the problems will be substantial: revegetation of spent shale material is a unique and unsolved problem which we suspect may not be solved for a long time, or ever, while the more"conventional" revegetation of disturbed soil is far from routine in an arid or semi-arid climate (contrary to implications in the EIS, I-I-57).

Three areas of information are critical to the reader of the EIS in determining the probable success of a prospective revegetation program: 1) the nature and magnitude of the disturbance requiring revegetation; 2) the level of technology available to replicate the original productivity of the area-- i.e. revegetate to the degree specified by the lease; and 3) the objectives and effectiveness of the revegetation program as specified in the lease.

Characterization of the disturbance: It is clear that the impact of the proposed program on vegetation (and hence animal habitats) will be massive:

> the aggregate impact on vegetation will be: 1) complete removal or burial of existing vegetative cover on disturbed areas, 2) reduced capacity to control erosion in all affected localities increasing the need for extensive solid waste management and attempts at

> large scale revegetation, 3) change in the mix of tree, shrub and grass species now occurring on the areas, 4) reversal of the natural plant succession toward an enduring climax vegetative cover type and 5) an adverse effect of uncertain degree and duration on the soil-holding capability of the introduced cover and its direct utility as substitute wildlife food and cover. (I-III-27,28).

Capacity to revegetate disturbed sites without spent shale: Successful revegetation with grasses, shrubs or trees has not been demonstrated over large areas:

> Grasses can usually be well established in 3 to 5 years on soils of the region. Successful establishment and enduring cover over large areas has yet to be demonstrated.... Successful establishment of shrub and tree cover over large areas and under varying conditions is uncertain. (I-III-25).

Capacity to revegetate spent shale: Technology does not now exist that can establish a diverse community of plants even for a short period of time:

> Establishment of initial cover and successional change on processed shale disposal sites will be constrained by the plant growth media, and the semi-arid climate, exposure, slope, and cultural practices, including temporary irrigation and fertilization. Revegetated processed shale areas will be fragile sites highly susceptible to damage from biotic influences such as improper grazing or fire....The reliability of establishing and maintaining an effective plant cover over the long-term is uncertain. (III-IV-33,34).

The lease terms: The stated objective for revegetation in the lease is that the lessee should provide permanent rehabilitation of the environment to a level that will support the same species and numbers of animals as at present.

> The Lessee shall restore the vegetation of disturbed areas by reestablishing permanent vegetation of a quality which will support fauna of the same kinds and in the same numbers as those existing at the time the baseline data was obtained.... (III-V-77).

The stipulation and enforcement of revegetation requirements under the lease are therefore critical if there is to be a substantial revegetation effort connected with the proposed oil shale program.

Therefore, from information in the EIS it is clear that: a) vegetation (habitat) destruction will be severe; b) no technology exists that can guarantee its regeneration; c) the revegetation goal stated in the lease is based on technological hopes.

2. Disturbed area revegetation without spent shale

One of the most significant obstacles to successful revegetation of disturbances where native soil is relatively intact is the assumption that it is an easy process. This attitude expressed in the EIS,could and may easily delay the initiation of much needed research.

> ...Several guides are available to successfully implement a revegetation plan... Of more that 400 species and 3,000 varients tested, about 75 browse, 75 forbs, and 55 grasses show usefulness for improving game ranges. (I-I-53).

The EIS uses overgeneralized information such as the above, as opposed to specific data applicable to the questions raised.

The problem of ecotypes is inadequately discussed also. An ecotype is a variety of a plant species that has acquired, over time, a collection of adaptations that enable successfully in a specific place. Plant ecotypes are adapted to the total environment of an area including: 1) soil structure, and mineral content; 2) rainfall; 3) temperature and climatic seasonality; and 4) light. Plant adaptation is highly specific to the local environment. In fact, plants that look alike in nature behave

very differently when they are grown under identical conditions. A study involving 4 Texas grasses (Panicum virgatum, Sorghastrum nutans, Andropogon scoparius, and Bouteloua curtipendula) has shown that when plants from 5 different collection sites are grown under identical conditions each species shows differences from population to population in blooming date, general stature and vigor.[1] Any plant that grows on a lease tract has adapted over geologic time to the specific environment found on the lease tract. Other members of the same species may be found in China, for example, but this does not mean that the Chinese variety could grow on the lease tract. Strains of the same species, though they may be commercially available, may not be capable of establishing long term vegetation on a lease tract.

The EIS dos not adequately discuss sources for seed. Native plants that are part of a stable community tend to conserve their reproductive potential by producing seeds that will germinate only under highly specific conditions. They differ significantly from commercial seed strains in this respect because commercial strains are selected for good seed germination. The best seeds for revegetation of an area are those produced by the plants of that area, but they may not germinate well, and are probably not commercially available.

A case in point: Oryzopsis hymenoides (Indian rice grass) is a native of all of the lease tracts. Because the tracts are not identical themselves we might find natural ecotypes if we were to compare the lease tract populations. If, however, we go to

1. Nixon, E. and C. McMillan, 1964. Amer. Mid. Nat. 71:114

the USDA seed catalog,[2] we find commercially available seeds of this species. The USDA seeds come from a strain which was selected from 152 varieties tested by that laboratory. The selected seed variety comes from plants native to Idaho. There is no assurance that Idaho plants have the adaptations necessary to grow permanently on lease tracts, even though we can be assured that the seeds will germinate.

The EIS does not attempt to deal with these obstacles to "conventional" revegetation. Research is needed to determine the nature of the environmental factors that control plant growth at each lease site. Studies are also needed to determine the comparative success of different ecotypes of the species that will be used for revegetation of disturbed areas. Source areas for seeds must be determined and germination requirements of seeds examined. Development of a technology that can predictably revegetate disturbed areas on lease tracts demands extensive research effort, and it is possible that the lessee may have to develop commercial quantities of seeds or shrubs suitable for the specific area. It would be unwise to wait until the lease period is well under way to begin this critical research.

3. Revegetation of Spent Shale

The problems of spent shale revegetation are many and complex. The above requirements for revegetation of disturbed soil apply here, but the difficulties are compounded by the fact that the spent shale is an entirely novel plant environment. It is doubtful that an

2. USDA publication 170.

equivalent environment exists for plants anywhere. The EIS does not address the question of spent shale revegetation adequately.

Establishment of certain exotic species and some native transplants on revegetation plots has been achieved, but only with daily watering, special complete fertilizer, and plently of mulch. One can expect that after regular "irrigation (is) withdrawn, the natural climate could not support these stands." (I-I-72) The potential success of a search for ecotypes that might prove stable on saline tailings is impossible to predict; such a search has not been completed. In fact, the problem of an ecotype search has not been adequately discussed in the EIS, as mentioned above.

Knowledge of the quantitative and qualitative composition of plant communities now growing at the selected tracts is important in order to be able to infer anything about the ecosystem and its dynamics. The measured differences between the native soils and the expected leached tailings are also of great consequence if revegetation is anticipated. These data exist in the Colony Development Corporation report, but they were not included in the EIS.

From the report we assume that implementation of the Tosco II process, the best-tested oil shale technology to date, would result in a contoured, terraced, fine-grained, saline, black, inert material - the spent shale. Several revegetation problems are created by the nature of this material:

a. Color--The material must be mulched. The mulch must cut down on the absorptive nature of the black material as well as prevent the erosion of the material during the irrigation process in order for vegetation to survive. No specific data are

presented in the EIS on this problem.

b. Salinity--In order to reduce the high salt content, leaching is proposed with added water. What are the comparative data on the water, compaction of the material, and its physical effect on plant establishment and vigor? Can local streams stand the increased salinity? Will upward movement of salts occur, invading the root zone and killing plants? The EIS does not include discussion on these questions as they relate to revegetation.

c. Inertness--It is mentioned in the EIS that the material could be fertilized. There is no reference, however, to a commitment to continue this over an extended period (20-30 years) to permit accumulation of material in a closed biogeochemical cycle.

d. Species composition -- Data not presented in the EIS but available through Colony Development Corporation show that by using exotics and adding water, soil, and fertilizer vegetation may be established. Colony also has some data on continuing management necessary to maintain even a completely novel community. Only three species mentioned in the Colony report seem to have demonstrated growth on 100% spent shale. Who will decide what species to use for revegetation? Where are appropriate ecotypes in existing vegetation going to be found?

e. Wildlife exclusion -- The EIS admits that plant communities developing on this material will be highly subject to damage from grazing herbivores (III-IV-33). It is thus very probable that, in order to comply with lease revegetation requirements, these areas will have to be carefully fenced and maintained as wildlife exclosures for a number of years; yet the EIS makes no mention of the impacts, cost or maintenance of such exclosures.

Salinity of the plant growth area of the soil is perhaps the most severe problem. Two alternative approaches to spent shale revegetation have been proposed, (I-I-67): 1) covering compacted spent shale with topsoil; 2) using leached spent shale with a surface mulch as a covering for compacted spent shale, with fertilizer added to supply missing minerals. Either of these options may allow initial seedling success if enough irrigation water is supplied. However, when natural rainfall becomes the primary source of water there is a very real danger that salinization of surface layers will occur. The compacted layer of spent shale which underlies the surface will be 250 feet thick, and extremely salty. (III-IV-12). At the point of contact between the surface layer and the compacted layer the downward progress of water will be impeded enough to cause it to "perch" - as moisture evaporates from the surface, soluble salts from the compacted zone will be drawn upward by capillary action and will be deposited at or near the surface of the soil. (I-I-45). Rainfall moves surface salt down but evaporation moves it up again. Even if run-off removes some salt, it will be replaced from the compacted zone. The net result of this system will be to produce salinization of initially non-saline soil in the root zone of the plant.

Although these potential salinity problems are mentioned in the EIS, the significance of upward movement of salts is completely lost: in fact, this phenomenon alone could prevent the establishment of permanent plant communities on spent shale.

Eventually, the compacted zone will weather deeply enough that salinity at the surface may be expected to decrease. Weathering

depth must exceed 7 feet, however, before the decrease in salt is to be expected. We do not know the rate of weathering, or what factors influence it, but substantial amounts of time may be required to produce an equable environment for plant growth.

The Soil Conservation Service has determined that initially, the tailings environment will be suitable only for salt tolerant species. (I-I-66). Studies conducted thus far have been of such short duration that there is a real question related to "just how salt tolerant must a species be to survive permanently on spent shale?" It must then be determined whether or not this level of salt tolerance exists.

A first requisite for survival on spent shale revegetation sites therefore, is salt tolerance. Many of the native species inventoried in the lease tracts do not possess this characteristic. The elimination of non-tolerant plants will significantly reduce the diversity of the plant community as initially inventoried. Loss of diversity in the plant community will limit the diversity of the animal community, and the lease specification will have to be breached relative to the "same kinds and numbers of animals."

The loss of non-tolerant plants, however, is not the only plant diversity loss that is to be expected. Salt-adapted plants display distinct soil texture and soil moisture preferences. Two native salt tolerant plants, for example, would be eliminated because spent shale will not satisfy their requirements in these areas: Shadscale is restricted to soils that are sandy and well drained while Four-winged Saltbush requires an essentially non-saline supply of ground water. Neither requirement will be met

on spent shale disposal sites. As each factor of the effective environment of the plant is accounted for, more potential revegetation species are eliminated. It is impossible to predict the diversity of the eventual community, but it is not at all probable that it will support an animal community of the same type as the initial one. This realization may have prompted the authors of the EIS to predict the possibility that a new community might develop "uniquely adapted to weathered shale". (I-I-72).

4. Revegetation Stipulations in the Lease

As has been mentioned above, the stringent lease requirement concerning revegetation probably cannot be met, especially with regard to spent shale. The EIS does not straightforwardly address this point, and the uninformed reader might assume that revegetation to duplicate the existing productivity of the land will actually result as a result of the lease. In fact, the lease does not absolutely require compliance with the revegetation goals. Rather, the lease states that:

> ...if in the opinion of the Mining Supervision, the Lessee has failed to demonstrate the required technology (for revegetation) he shall be required to submit for approval a program designed to obtain the required technology. (III-V-78).

This exception highlights several important features of the lease that substantially alter the apparent effect of the stated revegetation goal.

a. The lease permits the lessee to wait ten years before demonstrating the proper vegetation technology. (III-V-79). Thus, significant land

disturbance will occur even before it is known whether revegetation is possible.

b. The Mining Supervisor of the U.S. Geological Survey has been given the power to make all the important administrative ecological, agricultural, physiological and genetic decisions. Thus, he decides what type of plant community is acceptable at each site. He is given the legal power to determine what is a "proper" effort to revegetate. Standards for this "proper" effort are not defined in the EIS or the lease. In effect, the design for implementation of the latest revegetation technology and capability in applied ecology rests in the hands of a person with no expertise in this area.

c. The Mining Supervisor has the authority to determine that lands should be put to a new use after lease operations cease, in which case the lessee need not restore the land (III-V-78). Thus, if revegetation standards in the lease prove to be too high, the Mining Supervisor can simply decide to waive them.

d. After an initial expenditure by the lessee, revegetation costs will be paid by the government (and hence the public). (III-V-79). The maximum expenditure required by the industry will be $500,000 for the total lease area (5120 acres), whereas revegetation costs have been estimated to be as much as $5490 per acre for spent shale tracts in Colorado.[3]

3. Heley, W., and P. Kilburn, paper presented at Critical Area Stabilization Conference, Albuquerque, N.M., 5/13/73)

5. Alternatives to Revegetation of Spent Shale

It appears likely that re-establishment of stable plant communities on spent shale may not succeed, although the EIS merely labels the situation "uncertain." (I-III-25). Therefore, if oil shale development is to proceed, alternatives to revegetation could be considered, along with their relevant costs. For "giving up" revegetation means "giving up" on re-established wildlife habitat, and on a host of other significant values now inherent in the oil shale regions. But, the many risks inherent in managing tremendous quantities of erodable, leachable materials (such as spent shale) and the obligation of the EIS to consider alternatives indicate that it might be worthwhile to consider another approach to the spent shale problem.

One option would be to treat the spent shale dump surfaces with physical or chemical sealants and manage the sites as water harvest areas. This strategy would a) decrease the consumptive use of water in oil shale processing; b) increase the water yield from the dump watersheds; and c) produce high quality water essentially free of suspended sediments and dissolved solids.

Natural run-off from potential dump sites is probably no more than 5 percent of annual precipitation. Treating the dump surfaces to make them impermeable would increase the water-yield efficiency to perhaps 80 or 90 percent. Since annual precipitation in the oil shale region varies from about 7 to 24 inches, the water yield from treated dumps could approximate as much as 0.5 to 1.8 acre-feet per acre.

Such a project might prove no more complex or expensive than the maintenance of drainage and retention structures associate with more "conventional" methods of managing spent shale dumps. But clearly, this alternative would require a complete sacrifice of the goal of revegetation and other values, and so, of course, is not desirable in terms of biotic productivity.

Another alternative method which could be applied to spent shale dumps would be the use of a gravel mulch. This could be associated with a revegetation program and might help retain soil and water. This has been suggested as a means of increasing forage on rangeland.[4]

6. Conclusions

a. Revegetation of the potential land disturbances associated with the development of the prototype leasing program is not at present possible:

1. Technology for revegetation of native soils is inadequate and research will be required to determine which ecotypes and seed sources should be used.

2. Revegetation of spent shale is a problem that is even less understood. There is no reason to believe that it will be solved within the 20-year lease term.
Discussions in the EIS, though admitting these problems are, for the most part, optimistic in implication.

b. The lease contains a strong revegetation objective which is all but negated by other provisions:

4. Keller, W., 1971, "Limits on Western Range Forage Production -- Water or Man," Jour. Range Management, No. 146, 26 pp.

1. If technology for restoration does not exist, the lessee can proceed with development during his efforts to develop the requisite revegetation capability.

2. Post-operation land use can be redefined or reclassified by the Mining Supervisor, thereby allowing for much less stringent restoration.

c. The Mining Supervisor lacks expertise necessary to manage revegetation efforts on behalf of the public. The EIS includes no discussion of alternate mechanisms for supervision, such as by the Environmental Protection Agency.

B. Wildlife

1. Introduction

The purpose of this discussion is to assess the EIS analysis of impact of oil shale development on the wildlife of the project region in Colorado, Wyoming and Utah.

The wildlife sections of the EIS are lengthy, vague, evasive and often contradictory. Pertinent, incisive and straight-forward discussions are rare.

For the most part we have been forced to search, cross-reference and analyze for ourselves in order to construct a picture of the true impacts of the proposed program. That we have been able to do so at all is a tribute to the dedicated scientists in the Interior Department who worked hard to include sound, factual data in the EIS. These data alone, however, are insufficient for analytical purposes.

Many reviewers of the draft EIS commented that the analysis of wildlife -- both inventory and impact evaluation -- was deficient. It is instructive to note that most of the comments in this discussion were brought to the attention of the Department by those who commented on the draft.

Perhaps most significant is the EIS's failure to discuss the proposed oil shale program in relation to the nation's laws and treaties concerning wildlife preservation (see Section 8 of this review):

a. The Endangered Species Conservation Act of 1966, as amended, which specifies that the Secretary of Interior "shall seek to protect species of native fish and wildlife . . . that are

threatened with extinction."

b. The Bald Eagle Protection Act of 1942, as amended which declares that it is a federal policy to protect the national symbol.

c. The Golden Eagle Protection Act of 1962 which declares that it is a national policy to protect this species.

d. The Wild Horses and Burros Act of 1971 which directs the Secretary of Interior to take jurisdiction over the "management and protection" of these species.

e. The 1916 Convention between the United States and Great Britain for the protection of migratory birds.

f. The 1937 Convention between the United States of America and the United Mexican States for the Protection of Migratory Birds and Game Mammals, which specifies measures for the protection of these species.

g. The Migratory Bird Treaty Act of 1918 (40 Stat. 755 as amended) which implements the Conventions mentioned in e. and f.

For further discussion on this omission, see Section 8 of this review.

It must be emphasized, and remembered throughout this discussion, that each species of fish and wildlife is worthy in its own right--a vital part of a coherent, diverse ecosystem--regardless of man's interest therein. Only in these terms can wildlife values affected by oil shale development be helpfully quantified and evaluated in the EIS.

2. Wildlife Inventories

Judged in terms of the analytical objectives of an EIS, inventories of wildlife species in the general Colorado and Wyoming oil shale areas are adequate for large mammals and birds but not for most other classes of animals; for example, small mammals, amphibia, reptiles and invertebrates, and insects. The

Utah area inventory is wholly inadequate; it includes passing reference only to some game species plus a few furbearers, mammalian predators and raptors.

Inventories of the various wildlife species on the six specific lease tracts are inadequate.

3. Wildlife Quantification

Quantification is inadequate for the general oil shale areas of all three states. Where population or density figures are given they are usually in the form of broad estimates (e.g., 30,000 to 60,000 mule deer in the Piceance Basin of Colorado). Frequently hunter harvest figures are offered along with hunter success ratios; acres of habitat are also noted in some instances. Neither of these latter kinds of figures should be construed as adequate quantification. In most instances, no population data at all are provided, except for game species and wild horses. In at least one instance given data appear to be incorrect (i.e., over a dozen active golden eagle nests exist in the Piceance Basin, not four as the EIS maintains).

Sound quantitative information on wildlife and fish populations and densities is an essential starting point for any determination of environmental impact. In the absence of such basic data the EIS assessment of impacts on fish and wildlife (for example, I-III-193-196) must be regarded as speculative.

4. Regional Impacts on Wildlife

a. Quantitative assessment of wildlife impacts

As noted above, without quantification of wildlife as a baseline the EIS cannot be specific about the effects of oil shale development. In addition, the EIS narrowly defines impacts on fauna. Generally speaking, discussions of these impacts focus on actual land disturbance (i.e., habitat loss). This is true of the sections on both the oil shale areas in the three states and on the six lease

tracts.

In truth, however, oil shale development will create a compound, ongoing complex of disturbances in addition to actual habitat loss--noise, dust, traffic, activity, structures, potential changes in both the quality and availability of water, and probable adverse changes in air quality. Although most of these factors are mentioned, at least in passing, the EIS contains no realistic quantification of the impact of these actions on wildlife.

The most specific figure given for wildlife impact is the predicted 10% reduction in wintering mule deer in the Piceance Basin even "if disturbed areas and disposal piles are . . . revegetated with suitable winter browse species" (I-III-179). However, elsewhere it is noted that such revegetation is unlikely, so the figure is, at best, as the EIS admits, "an estimated minimum." No maximum is given, and the means of estimating the 10% minimum figure are unexplained. The EIS otherwise evasively maintains that "there is no reasonable way to quantitatively assess, before the event, regional environmental effects resulting from a broad spectrum of land uses and human activities" (I-III-172).

b. Qualitative assessment of wildlife impacts

Typical of the EIS assessment of wildlife impacts is the following response to reviewers' requests for clarification of impacts on wildlife:

> In general, the native fauna of the oil shale region would react to industrial development and urbanization in the same way fauna have reacted to the pressures of expanding population and land development in other parts of the United States. Species such as mountain lions, elk, large raptors, and grouse, which, because of unique behavioral traits, are intolerant of human activity, will retreat from the area, and their numbers will be reduced by the loss of available territory. Deer herds will be reduced for the same reasons, but, being more tolerant, they will not retreat as far. Increased interference with their migratory routes will tend to favor those animals that do not migrate and alter the behavior of herds over time. Losses of native fauna can be related to the level of development and the populations of intolerant species will be reduced. More

> tolerant species and species which utilize smaller territories will also be reduced in numbers, mainly by the physical loss of habitat and the impact of introduced pollutants such as dust, pesticides, polluted waste water, and noxious effluents from industrial processing. (IV-III-54).

Stripped to essentials, the assessment of regional impacts on wildlife in the EIS is both broad and sweeping. Major impacts named:

1) Most wildlife will be reduced. (I-III-73).

2) Predators will decrease. (I-III-172).

3) Stream and spring depletion will reduce wildlife. (I-III-172).

4) Wilderness species will be lost from the area entirely (possibly including mountain lion, black bear, elk and various raptors, particularly the eagles and falcons). (I-III-171 and 195).

Given these declarations, however, the critical questions are: what will be the environmental effects of such wildlife destruction on the undeveloped lands near the oil shale tracts? What ecosystem changes can be forecast from changed or destroyed migration patterns or predator-prey relationships? The EIS does not tell us because it neglects to take an ecological approach to wildlife analysis.

5. Tract selection

The selection of Colorado tract C-a is a particularly poor choice with respect to impact on wildlife. As the authors stated in response to criticism on this matter,

> . . . (its) selection is consistent with the program objective of stimulating commercial oil shale production and technology, while minimizing adverse environmental impacts. (IV-III-66).

The particular tract in question is an area managed for wildlife (in particular, mule deer) by the Colorado Division of Game, Fish and Parks. It is an important part of the range for the largest migratory deer herd in the United States. If developed, an important migration route would be disrupted, resulting

in the displacement of a large number (not estimated in the EIS) of animals, perhaps in the thousands. Development of tracts in the center of the semi-primitive basin (both C-a and C-b) would create especially heavy impacts on wildlife.

Clearly, minimization of impact on wildlife has not been a significant factor in design of the oil shale program. With respect to the selection of tract C-a, if not all of the tracts, commercial potential obviously overshadowed wildlife values.

6. Wildlife and the re-establishment of vegetation.

The long-term survival of wildlife populations in the oil shale region depends in large part on successful revegetation. Though reference to the fact seems unduly buried in the EIS, it is clear that revegetation for wildlife is most unlikely. It appears that increasing areas of vital habitat will be irrevocably lost due to oil shale development.

Discussions of wildlife impacts tend to treat the existence of the individual mining operations primarily as temporary disturbances--with the promise that, after 20 or 30 years, the sites will be fully revegetated and the attendant implication that wildlife communities will come back more or less as before. Such a suggestion is based on at least five assumptions not supported in the EIS, namely:

a. that revegetation will occur;

b. that the revegetated cover will be of a kind and quantity that will support wildlife;

c. that sufficient "seed" populations of wildlife will somewhere and somehow sustain themselves for the duration of the industry;

d. that the springs and streams dried up during the mining operations will replenish with water of suitable quality for wildlife; and

e. that, when an oil shale operation terminates, disturbance factors will diminish to their pre-development level.

These are inaccurate and misleading assumptions (see section 5-II-A of this review).

Briefly, the major problems with respect to the relationship of wildlife and revegetation are as follows:

a. Basic uncertainties exist as to the possibility and nature of revegetation. (III-IV-32).

b. Revegetated spent shale will be very fragile, and may not withstand grazing. (III-IV-33).

c. Revegetation on spent shale will be limited to salt-tolerant species that, in general, are unsuited to wildlife. (III-IV-34 and I-I-71).

d. It is doubtful that forage for wildlife can be re-established on spent shale. (I-III-178).

e. Without appropriate forage species, wildlife will decline drastically. (I-III-178).

f. Canyon disposal sites for spent shale will be unsuitable for many species, even if revegetation can be accomplished--small birds, eagles, coyotes, bobcats, mountain lion, foxes, ringtails, skunks, weasels, and other smaller mammals, deer, wintering elk. (I-III-178-179). Riparian habitat, key to many animals, would be lost completely.

g. Revegetation is not planned to benefit wildlife in that if revegetation to former conditions cannot be accomplished, revegetation to another purpose is allowed. (III-V-78).

To date, realistic revegetation of oil shale lands with native vegetation which will support current wildlife populations has not been demonstrated. The technology simply does not exist. The EIS recognizes this and, as a result, confidently predicts the drastic reduction of some species of wildlife and the complete

extirpation of others. Therefore, the primary lease provision requiring revegetation to support native fauna in species and numbers prior to development is both unrealistic and deceptive. It appears, instead, that the Interior Department will be content with revegetation of exotic grasses and salt-tolerant species which will, at most, permit livestock grazing as a viable after use on the oil shale lands.

7. Conclusions

a. The major impacts on wildlife from oil shale development on the public lands would be upland habitat losses from the mining operations, loss of riparian (streamside) habitats and water in canyon bottoms from disposal of saline spent shale, impacts from noise and disturbance that would eliminate big game over large areas, and impacts from the influx of people that would use the area for recreation.

b. Wildlife impacts of an oil shale industry in Colorado would be less if the developments could have been planned for public or private lands or the periphery of the Piceance Basin. This was not discussed in the EIS.

c. The EIS reveals that wildlife values received only minor attention in the course of oil shale program design and impact analysis. The expressed national policy of preservation of rare and endangered species has received similar lack of emphasis.

d. Lacking sound quantitative data on wildlife and fish populations, the EIS assessment of impacts on the vertebrates are speculative, unanalytical and inconclusive. Substantial impacts would, of course, occur.

e. The EIS lacks examination of ways in which wildlife species can be conserved, even including rare and endangered species.

f. The lease lacks effective provisions for protection of wildlife.

g. The EIS does not discuss efforts that might maintain wildlife populations during operations. A cooperative state-federal wildlife management plan with maintenance of wildlife as its objective would have been one mechanism to examine in the EIS.

III. SOCIAL IMPACTS

A. Economic Analysis in the EIS

The EIS is extremely deficient in the area of economics. Even the most basic tools of economic analysis are not employed by the authors. The role of economic factors in potential oil shale development is neither discussed nor apparently understood; the anticipated economic impacts of the proposed prototype program are not thoroughly analyzed.

1. Basic tools of economic analysis

a. The cost-benefit analysis

Although not clearly required under NEPA (see section 8 of this review), the cost-benefit analysis is one way of presenting economic and other data in a format which facilitates evaluation. No such comparative analysis is attempted in the EIS, nor is any other evaluative mechanism used or suggested. This is a serious deficiency in a document intended to assist the decision-making process for the proposed oil shale program.

In the Coordinating Committee v. Atomic Energy Commission[1] it was held that "The particular economic and technical benefits of planned action must be assessed and then weighed against the environmental costs." This decision would imply that some balancing mechanism is needed to give the decision-maker and the public a framework for analysis.

In the case at hand, the EIS does not attempt to show that the economic, social and environmental benefits of oil shale development outweigh their costs. While some of the most important costs and benefits of a project may well be difficult or impossible to quantify, the underlying principle of weighing costs and benefits remains valid. "A good benefit-cost analysis . . . not only has always compared the monetarily measured benefits and costs, but also has described

1 Calvert Cliffs' Coordinating Committee v. Atomic Energy Comm'n, 449 F.2d 1109, 1 ELR 20346 (D.C. Cir. 1971), cert denied, 404 U.S. 942 (1972).

in whatever terms were feasible the non-quantifiable noncommensurable benefits and costs."[2]

In order to make an informed judgment of the proposed leasing program, one should have access to data on the relevant economic and environmental parameters. Although an attempt has been made in the EIS to present some of the requisite data, the reason for doing so, or for not presenting more analysis, is unclear. No attempt to weigh and compare economic data with other data has been made.

It should be noted that a determination that a project's benefits, however measured, exceed its costs, is not sufficient to recommend a project. In a world of limited resources where all projects fitting that criteria cannot be simultaneously undertaken, a project should not be undertaken unless its net benefits exceed those of other projects which could be undertaken with the same resources. Thus, while it is conceivable that oil shale development has positive net benefits, it should not be approved unless the same funds cannot be better employed in other ways. In other words, an optimum should be sought.

b. Price-demand elasticity

An important economic factor in evaluating potential oil shale development in itself and in relation to alternatives is price-demand elasticity. The price-dependent changes in quantitites demanded and supplied are called by economists the price elasticities of demand and supply, respectively.

Under the proposed leasing program, oil shale development will be carried out by private, profit-responsive firms. Therefore, the rate of exploitation will be responsive to changes in the price of oil and the price of alternative fuels. The EIS fails to analyze the effects of price changes in energy markets. Nor does it consider the fact that as the price of a good rises there is usually a tendency for consumption to diminish.

2 C. Howe, Benefit-Cost Analysis for Water Systems Planning, American Geophysical Union, Washington, D.C. 1971, p. 15.

Although the EIS admits that "higher prices and/or improved technology would make it profitable to extract substantial amounts of additional oil from fields which are economically marginal" (II-III-17), there is no substantive analysis of the relation of either supply or demand to the price of petroleum products (see section 4 of this review), nor is the reverse possibility evaluated.

Land use is also price elastic. It is therefore impossible to know what land use decisions the oil shale firms will make unless one knows the true costs to the developer of various mining, processing and revegetation techniques. These costs in turn depend on the degree of land restoration and revegetation required and enforced. However, land use costs are ignored in the EIS as if they had no effect on how much land will be used (I-III-8-30).

The absence of such discussion in the EIS detracts considerably from the credibility of its analysis, particularly of the judgments made on the economic viability of oil shale development.

2. Weighing the alternatives

As is discussed elsewhere in this review (sections 3 and 4), the EIS has failed to analyze completely the factors involved in comparing the various alternatives to the proposed program. Although the Department has clearly concluded that the proposed program is preferable to the alternative program designs, and that oil shale development is preferable to other energy solutions, this program is not justified or supported by a balancing mechanism, such as cost-benefit analysis, that is capable of weighing the essential data. In addition, the data themselves have not been generated from complete analysis, particularly with respect to economic factors. In particular, failure to recognize the importance of price and cost changes in an evaluation of energy alternatives makes the EIS misleading if not meaningless in this respect.

3. The true costs of oil shale development

The true costs of oil shale development are not presently known. However, the potential exists for large financial burdens on the government as a result of the proposed program and of oil shale development in general. These public costs have not been discussed in the EIS.

Attempts to forecast the probable economic viability of oil shale development should be a crucial part of deciding whether to proceed with the proposed program. The cost of environmental quality, including community services, and the long-term maintenance of necessary dams, conduits, and revegetation efforts after the termination of the leases should be thoroughly discussed in the EIS.

It should be noted here that the Department proposes substantial subsidies to the developing companies. For example, the federal government will pay the bill for any "extraordinary costs" of environmental protection:

> This provision is designed to give the Secretary discretion to take action where the economic viability of a lessee's operation is threatened by costs which were not in the parties' contemplation at the time of the issuance of the lease. To make an oil shale lease containing terms so difficult as to make development uneconomical would be incompatible with the objective of developing a viable oil shale program (IV-III-156).

Clearly, therefore, complete cost internalization to the oil shale industry plays no part in this program. Perhaps, for a short-term, purely experimental endeavor this is a good policy. But the Department's evident intent is to develop commercial scale production. Because of the public subsidy provision, therefore, oil shale development may appear to be more economically viable than the "prototype" operations would suggest.

4. Conclusions

a. Economic benefits are quantified in terms of maximum possible development, while likely environmental costs are incompletely presented. This technique makes the potential for economic benefit loom deceptively large over the potential

environmental harm.

b. The concept of price-demand elasticity is ignored in the EIS as if it did not apply to oil shale at all.

c. The benefits and costs of oil shale development have not been presented in a manner to show how they might be balanced by the federal decision-makers or by the general public.

d. Data used to compare economic benefits and environmental costs are biased in favor of oil shale development while the alternatives and the optimal use of the resource are not systematically evaluated.

e. The lease stipulations dealing with environmental protection suggest that many of the costs, particularly long-term costs, may be paid out of public funds.

f. Certain basic economic tools are not applied in the analysis of energy alternatives, limiting the usefulness of the EIS as a helpful decision-making document.

B. Regional Considerations

1. Introduction

The CEQ guidelines of 1971 specifically charge that the effects of any possible change in population patterns upon the public services of an area should be included in the analysis of environmental impacts. (Council on Environmental Quality Guidelines, Section 6). Although the Department does characterize the proposed program as the potential cause of regional growth and environmental deterioration, no positive steps are suggested which might prevent, control, reduce, mitigate, correct or compensate for these impacts. This is a basic flaw in the EIS.

In general, the EIS approach to regional impacts of oil shale development is as follows: There will be important regional development effects, but mitigation of these is not the responsibility of the Department or the federal government. The Department interprets its responsibility as merely to advise as to the nature of regional planning problems, in particular through the mechanism of the oil shale Technical Advisory Board described in the proposed Secretarial order (IV-I-15-17).

In addition, the sequence and magnitude of the impacts may not be as reported in the EIS; the projected impacts are based on a development schedule that was selected arbitrarily and represents maximum development (I-III-6-9). It would be more realistic to consider how development is most likely to occur over time and then to make economic projections. The EIS authors dismiss this approach by saying that different development schedules are not likely to

change the nature and magnitude of the impacts (I-III-8). This is not true, in particular, for economic impacts.

The authors' conclusion regarding regional economic impacts is deceptively simple.

> Changes in the economic environment would probably be regarded by most people as being beneficial due to the availability of new jobs, increased income and capital flow, increased tax base and services, and an immigration of people. (I-V-6.)

However, as described in a recent USDA publication, "new manufacturing plants not infrequently cost rural communities more than they return in tax revenues."[1] This review is not intended to refute the possibility of local benefits from oil shale development but rather to point out the uncertainty of projecting such benefits.

2. "Boom" and "Bust"

A major deficiency in EIS discussion of anticipated socio-economic impacts is that there has been no discussion of what might happen after the period of economic and population expansion accompanying oil shale development. In other words, although the discussion of population generated in the region by the program (I-III-204-206) may be accurate, the projections and analysis of effects only cover the "boom" side of the equation and neglect a possible decline, or "bust."

The predictable effects of the influx and outflow of construction workers, together with the possibilities of program failure, plant shutdowns, and the eventual decline of even a successful oil

1. Garrison, Charles G., "Impacts of New Industry on Local Government Finances in Small Towns in Kentucky," Sept. 1970, U. S. Department of Agriculture, Washington D.C.

shale industry, could have devastating impacts on local economies. Most public facilities needed to accommodate the boom situation will have to be financed out of bond issues that can entail local financial obligations far into the future. Powerful political pressures might well result in future federal subsidies of the local economies to avoid repetition of the Appalachian fate.

3. Time Lag Between Need for Services and Receipt of Revenue

There are other problems associated with the lack of federal responsibility in the regional development sector -- for example, the time lag between needed urban services and the revenues generated by taxes. This problem is raised in the EIS (I-III-219), but no mention is made of the fact that the emergency bonding capacities of many communities might be exceeded. The normal course of issuing bonds will not solve the problem. The statement, "Overall tax revenues should be large enough to amortize the required urban capital expenditures," (I-III-225) is therefore extremely misleading. It is also noted that much of the urban development will occur in counties other than the county in which a plant is located, but the authors respond only that "this problem is not unique to the oil shale area," (I-III-226).

Though it is theoretically possible for states to legislate new taxing provisions (I-III-226), experience has shown this to be a difficult and time-consuming process. If urban adjustment is to be successful, provisions for reallocation of tax revenues must be formalized before a boom period begins. The EIS fails even to recommend ways in which this reallocation process could be accomplished in time to prevent urban system overloads. The suggestion that

loans might be available under the Urban Growth and New Communities Development Act (I-III-226) is not accompanied by assurances that such funding would be timely or sufficient.

4. Mobile Homes and Property Taxes

Another serious problem involves the high proportion of housing that would be in the mobile home category. This problem is mentioned (I-III-222), but it is not evident from the calculations in the EIS whether the proportion of mobile homes to permanent homes is realistic nor how the tax disadvantage to the local governments was calculated (a mobile home is worth about one-fourth the value of a permanent home in terms of local tax revenues).

5. Other Social Services and Associated Problems

The EIS analysis of Social and Community Impacts (I-III-228-231) is inadequate in every respect. The estimate that only five hundred additional classrooms will be needed in the region (I-III-222) is probably low, perhaps by a factor of three, but since there is no regional development plan or profile that describes the costs and benefits of regional development, critical comments cannot be based on the data provided in the EIS.

Sewage treatment for urban areas and small towns will be a problem that is recognized (I-III-223), but again no provision is made for coordination of EPA sewer subsidies in such a way as to assure orderly growth and development.

Other essential social services are not even considered in the EIS. The impact on local medical facilities, federal, state

and county welfare and employment compensation departments, psychological counselling services and fire protection facilities are not even mentioned. Crime and recreation patterns are noted, but no attempt is made to assess their impact. For example, given the long lead time necessary for the construction of hospitals, efforts will be required at all levels of government to prevent overcrowding of existing facilities. There is no assurance that additional medical personnel, physicians and technicians can be attracted to the area.

While the EIS does acknowledge that some new inhabitants "will not want to or be as capable of making the adjustments even for a relatively short period of time and will influence the worker turnover rate," (I-III-228), no mention is made of the consequent increased load that welfare and employment compensation agencies will bear. Other rural communities experiencing "booms" generated by mineral extraction industries have been forced to bear the financial burden of expanding the capacities of these agencies.

Facilities for recreation, crime prevention and fire protection will likewise be overburdened without considerable advance preparation.

The contention by the EIS that, "The subjective value judgments on life involved in evaluating these effects preclude accurate assessment" (I-III-229) is incorrect. The methodological tools of social scientists are more than sufficient to assess the present capabilities of these social institutions. If the population projections of the EIS are reasonably accurate, then projections

for the required future capabilities of these above mentioned elements of the social infrastructure can be made reasonably accurately. Interior has been remiss in its analysis of social and community impacts.

A number of extremely serious problems are touched upon superficially: urban sprawl (I-III-222), ground water pollution (I-III-223), crime, employment, living pattern disruption, school crowding (I-III-229), and high rents and property values forcing out long-time residents (I-III-231), social unrest (I-III-231) and social stratification (I-III-231).

Alternative solutions to these problems, such as a government/industry development corporation, conditioning a leasing program upon requirements to form regional planning authorities, or creation of a federal structure for insuring a coordinated inter-agency effort to reduce, mitigate or solve these problems, are not discussed in the EIS. Finally, it should be mentioned that virtually all of the problems discussed here and in the EIS result from a limited development; EIS analysis of socio-economic impact is curiously based on oil shale production of 400,000 barrels per day by 1981, even though this limitation does not conform to other analyses in the EIS. Aggravation of socio-economic problems caused by a million barrel a day industry should have been discussed or highlighted. The impacts of a possible "mature" industry are not discussed at all in the EIS.

6. Conclusions

a. EIS data on regional impacts are incomplete and poorly documented.

b. The EIS failed to outline the positive and cooperative steps the federal government could take at this stage to alleviate impacts on the region. For example, it neglected to show how financial burdens to local communities could be diminished by various alternative programs such as federal assistance measures in advance of development.

c. The EIS did not discuss the need for a regional development plan indicating the number, scope and magnitude of major impacts stemming directly and indirectly from the development of oil shale. Such a plan could show locations and corridors for reservoirs, stream diversions, canals, pipelines, railroads, transmission lines, roads and industrial developments. The plan could indicate how needs for housing, energy, transportation, and water might be met most expeditiously.

d. The EIS's only suggestion for mitigating adverse socio-economic impacts is that "Careful planning at the local level will be required for orderly growth and development." (I-III-30).[1] The serious difficulties that local governments will have in responding to this recommendation are ignored. Whatever might be said about the propriety of the federal public policy that is suggested by the EIS, this truncated response to a critical and inevitable socio-economic issue raises serious questions about the utility and purpose of the oil shale EIS.

1. Other federal agencies (e.g.: Department of Defense) often include in their EIS's the results of collaborative planning with local agencies.

C. Aesthetics

The six volumes of the EIS include ten paragraphs devoted to a description of aesthetic characteristics. Of the 26 sentences in those paragraphs, 12 repeat thoughts or material in other sentences, leaving 14 sentences devoted to "esthetic resources."

It is clear that there will be major aesthetic impacts from oil shale development. Disturbances of vast areas of land, creation and disposal of large quantities of spent shale (tailings), difficulties of revegetation, deterioration of air and water quality and the impacts of increased urbanization are all factors that should have been analyzed for aesthetic effects in the EIS. Unfortunately, this has not been done.

Neither the regional nor the tract-by-tract descriptions of aesthetic resources are in any way complete. An attempt has been made to list the "principal features" on each of the tracts (III-Tables II-2, 3, 5, 7). These tables, however, provide an inventory of roads, springs, trails and wells -- features that are listed according to the legal descriptions of the area in which they occur, without narrative to describe important aesthetic relationships, significance or unique attributes.

The EIS presents additional information relevant to aesthetic quality, such as descriptions of climate, physiography, fauna and vegetation, but this information is disjointed and hardly integrated sufficiently to create the visual images necessary for aesthetic analysis. To the extent that the landscape resource needs to be understood before the impact of oil shale development can be predicted, a discussion of aesthetics should attempt to convey--verbally and/or graphically--an accurate picture of the present landscape.

1. Specific comments

a. The EIS describes neither the sites nor the surrounding landscapes.

Land requirements for facilities are estimated (for example, I-III-20), but the potential aesthetic impacts are not assessed for pipeline rights-of-way, powerlines, roads or storage areas.

b. Recreation and aesthetics are consistently lumped together:

> Oil shale development will degrade the recreation and associated esthetic resources and activities of the region. (I-III-200).

While aesthetics and recreation are related, they are, as landscape architects, artists and others will attest, clearly distinct.

c. The EIS provides no answers to such basic queries as: the views that will be affected, their vantage point, or the depth or distance of a particular vista.

d. "Natural landscape" is used as a point of reference for rehabilitation and revegetation, but it is never described. Such a description would include:

i. An inventory of existing visual characteristics of the sites, including the surrounding area. At the very least, highway corridors, ridges, canyons and draws should be described. This could be accomplished by a verbal and/or photographic essay.

ii. Description of characteristic vegetation groups from a visual point of view.

iii. A topographical analysis to determine the characteristic form of the landscape. An analysis of possible alteration of form--for example, through open pit mining, tailings disposal, road-building, etc.--should be included.

e. The lease is particularly vague on points relating to aesthetic quality. For example: "The lessee shall consider existing aesthetic values in all planning. . . ." (III-V-81). Whose values will he consider, and, after considering them, what precisely should he do?

Similarly, provisions for restoration and revegetation are not useful without investigation, definition and advance planning.

f. According to the lease, man-made structures are to "blend with the natural landscape," and design and construction of roads, pipelines and transmission lines "shall . . . be performed so as . . . to achieve harmony with the landscape." All such requirements are, of course, only "to the extent practicable." (III-V-81).

This approach may prove to be ineffective in establishing aesthetic guidelines. In many cases, where attempts to "harmonize" with nature will fail, well-designed contrast might be preferable.

2. Conclusions

a. Aesthetic analysis in the EIS is not sufficient even to establish baseline information.

b. The authors evidence no clear conception of the meaning of aesthetics. Instead their analysis in the EIS demonstrates a confusion of recreation, aesthetic and natural landscape parameters.

c. The lease terms seek to protect aesthetic values, but without definition or baseline data this protection appears doubtful.

IV. CERTAIN OFF-SITE IMPACTS

The EIS omits discussion of major off-site impacts directly caused by oil shale development. Many indirect off-site impacts are also neglected. The Council on Environmental Quality has consistently maintained that environmental impact statements must contain analyses of what it terms "secondary" impacts.[1] New CEQ guidelines to become effective in January, 1974, stress the importance of these impacts: "Such secondary effects, through their impacts on existing community facilities and activities, through inducing new facilities and activities, or through changes in natural conditions, may often be more substantial than the primary effects of the original action itself."[2]

Population growth required to support an oil shale industry will trigger a host of impacts on the human and natural environment. In addition to the socio-economic effects discussed earlier in this review (Section 5III B), support facilities such as water supply, sewers, power supply, and recreation will all cause environmental changes. The EIS should consider the combined effect of these changes.

In addition, it is anticipated that ancillary industrial development will be directly stimulated by the existence of oil shale development -- in particular, mobile home manufacturing, fertilizer manufacturing (utilizing chemical by-products from the oil shale industry), and minerals processing (nahcolite and dawsonite). Other industrial development may be indirectly stimulated by the existence

1. Council on Environmental Quality: Statements on Proposed Federal Actions Affecting the Environment, Federal Register, April 23, 1971.
2. Federal Register, August 1, 1973.

of a ready labor force, energy supply, etc.

The most startling analytical omissions in the EIS involve the effects of anticipated major supporting facilities necessary for oil shale development. Among these anticipated facilities are:

(1) Electrical generating facilities -- 1600 Megawatts (Mw) installed to support the one million barrel per day level;

(2) Major water reservoir, diversion and transportation facilities;

(3) Pipelines and/or other product transportation, highways and other road improvements and utility corridors.

A. Population Influx

The environmental impacts attendant to rapid urbanization of the oil shale region will be substantial. Yet, in addition to the socio-economic factors discussed previously in this review, the EIS discusses the potential impacts of urbanization only in the most vague and general terms. For example:

> Increasing population growth in the region as a result of oil shale development, along with the associated human activities, will have an adverse effect on existing flora and fauna of the region. (I-III-186.)

> An expanding population and road system will intensify recreational land uses of the national forests, national parks, monuments, and recreational areas which are located in and around the oil shale region. (I-III-29,30.)

The EIS does estimate land requirements for increased urbanization (I-III-22) and mentions the need for large amounts of land devoted to temporary housing during the construction phases, but it omits discussion of the likely environmental impacts of these and subsequent developments.

B. Ancillary Industry

The probability that oil shale development will spur related and/or unrelated industrial development in the region is described in the EIS as "a final factor that needs to be considered." (I-III-35,36.) It is mentioned specifically that such ancillary industrial development might increase water requirements (I-III-36, III-42), but no other impacts are discussed. The potential problems of air quality, supporting facilities, land use, etc., can, clearly, be analyzed. Lack of specific data or particular plans for ancillary industrial facilities need not prevent predictive analysis in the statement.

C. Major Supporting Facilities Necessary for Oil Shale Development

1. Electrical generating facilities. Cooling water requirements for the projected 1600 Mw of electrical generating capacity are discussed in some detail (I-III-38-40). This analysis assumes that the power will be generated in fossil fuel-burning plants, though it is stated that some of the power could be imported from outside the region.

A 1600 Mw power plant would be more than 2/3 of the size of the oft-criticized Four Corners plant. The environmental impact of a generating facility of this magnitude (or a group of facilities) involves far more than the need for cooling water as the many published EIS's on fossil fuel power plants can attest. Air pollution impacts, resource supply (perhaps strip-mined coal), land use implications, transmission facilities, the impact of supplying cooling water -- in short, all of the impacts associated with large

electrical generating facilities -- must be examined in detail. They will be direct and inevitable effects of oil shale development undiminished in significance by their off-site location.

2. Water Supply

Major reservoir, diversion and pipeline facilities will be necessary to provide the large quantities of water required for a reliable supply to oil shale operations and supporting urban populations. In order to demonstrate the magnitude of the water supply problem, it should be noted that human requirements in the Piceance Basin area of Colorado alone would grow by a factor of 2.5 to 4 with the development of an oil shale industry. To this growth must be added the water requirements of the industry itself. With the exception of the following statement, the EIS made no attempt to identify or analyze expected impacts of any aspect of water supply systems:

> New impoundments, were they to occur, would affect the recreation uses of the rivers, creating increased opportunities for such activities as boating, but decreasing the eligibility of the rivers for classification as wild and scenic. (I-III-71)

There is no attempt to analyze impacts on wildlife habitat, water quality or other impacts of needed water projects, even in general terms. It should be noted that potential future impoundments are identified (I-II-25, 26, Table II-3, and I-III-55) quite specifically, so that detailed analysis would have been possible.

An additional area of appropriate investigation in the EIS would have been the consideration of water supply alternatives.

These, however, are not identified.

3. Pipelines, Highways, and Utility Corridors

Except for mention of land requirements for corridor rights-of-way, there is no attempt to investigate the impacts of anticipated supporting facilities such as transportation and utilities. It is clear that the potential impacts are large and predictable enough to permit meaningful analysis at this time.

D. Conclusions

1. The EIS contains no analysis of the off-site impacts of major supporting facilities necessary for oil shale development. These include large electrical generating plants, major reservoir, diversion, and pipeline facilities for water supply, and highways and other utility corridors.

2. The EIS does not consider the secondary impacts resulting from the large influx of people required to operate and support a regional oil shale industry. These go beyond basic land requirements to water and power supply, sanitation, recreation, and other predictable impacts attendant to rapid urbanization.

3. The probability of ancillary industrial development is mentioned, but the concommitant problems of land use, water supply, air quality, etc. are not analyzed.

4. According to a basic principle of ecology, everything affects everything else. The argument is therefore often heard that in environmental impact analyses "you've got to draw the line somewhere." And this is true. But just as traditional economic analysis of a proposed water resources project often involves a discussion

of offsite effects, such as "multipliers," so environmental analysis should embrace the significant changes that are forseeable if a given program begins. The offsite environmental events likely to occur if oil shale development occurs can, and consequently should, be identified and evaluated in this EIS. By neglecting to make these analyses the EIS fails to present to the public and to the federal decision-makers the kind of information necessary to make an informed program evaluation.

SECTION 6

PUBLIC PARTICIPATION

During the evolution of the oil shale leasing program presented in the EIS, the public had several opportunities to participate and contribute points of view to federal decision-makers. The National Environmental Policy Act presents the public with two opportunities for formal participation, one during the period required for public hearings and comment after issuance of the draft EIS, and the other during the period after issuance of the final EIS, before the Secretary makes his decision about the proposed program. The general public might also have represented its interests through the Governor's Oil Shale Committees in Utah, Colorado, and Wyoming. Lastly substantive dialogue might have developed during informal consultation between members of the public and Interior. (However, consultation with the public was apparently viewed by Interior as providing public information rather than providing for real public input.)

The purpose of this discussion is to analyze the effectiveness of these opportunities, which are largely described by Interior in Volume IV of the EIS entitled "Consultation and Coordination with Others."

I. OPPORTUNITY FOR PUBLIC COMMENTS

Though the beginning of Interior's Oil Shale study in October of 1969 marked the inception of the present oil shale program, the public hearings on the draft, in October of 1972, provided the first formal opportunity for public review and contribution. (There was an early "preliminary" draft printed in June of 1971 which did not receive formal review.) In September of 1972 the three-volume draft EIS was released, and public hearings were held during the following month. The period for written comment lasted through Nov. 7. Consequently, after a year and a half of program design, the public had little more than a month to prepare oral comment at hearings, and only a little longer to submit written comments. A year

later came the publication of the EIS in six volumes and 3,200 pages. Again the public review period was short (60 days) relative to the immensity of the material to review.

II. PUBLIC PARTICIPATION IN THE HEARINGS

A recent telephone poll of over a dozen participants at the hearings revealed that nearly all had experienced serious difficulties in reviewing the three-volume draft in the time permitted before the hearing. The most common difficulties involved the excessive length of the documents and the inaccessibility of the copies. Though about 1,000 were published, copies were in short supply at the three distribution centers. According to the Bureau of Land Management offices, demands for copies were heavy from industry and the public. Some citizens who requested copies never received them. For example, the mayor of Meeker, Colorado (a town in the oil shale region) reported in his testimony that he received his copy only a week before the hearings. One large state agency, the Colorado Fish and Game Department, received only one copy, affording it inadequate time for thorough analysis and criticism.

Reading and analyzing the material was difficult because of poor organization and editing of the draft. Many people found the volumes repetitious, contradictory, vague or otherwise poorly written, thereby complicating their critical review.

The hearings themselves did not incorporate the public's interest in understanding and contributing to the oil shale development decision. No opportunity was presented for dialogue between witnesses and those presiding at the hearings. Useful questions and discussion were thus precluded.

III. PUBLIC RESPONSE TO THE DRAFT ENVIRONMENTAL STATEMENT

Response to the draft from all sectors was considerable, both at the hearings

and during the written comment period. The tables below indicate the sources and geographical distribution of these comments. They show that contributions from private citizens and citizen groups were substantial, and that interest in the proposed oil shale program was particularly high in Colorado.

	Response to draft at hearings	Written comments on draft
Government	27%	13%
Private industry	24%	12%
Citizens' groups	30%	12%
Private citizens	19%	62%

Origins of comments--industry

Colorado	Utah	Wyoming	Outside
25%	1%	9%	65%

Origins of comments--governmental	
Department of Interior	18%
Other federal agencies	13%
Colorado agencies	29%
Wyoming agencies	10%
Utah agencies	13%
Other	17%

Origins of comments--environmental groups by interest	
International interests	2%
National interests	47%
Colorado interests	37%
Rocky Mountain interests	6%
Other	8%

IV. CONCERNS VOICED IN THE PUBLIC REVIEW

The public questioned nearly every aspect of the oil shale leasing program and the draft EIS. Review comments ranged from detailed specific analysis and comment on various aspects of the environmental impacts, lease stipulations and off site problems, to demands that the government cease all planning for an oil shale leasing program. Frequent concern was expressed about adverse environmental and socio-economic impacts of oil shale development, the need to explore new energy technologies and sources, the need for further studies and planning, the problems associated with supplying water to oil shale developments, the volume of spent shale, air quality, and wildlife habitat destruction.

V. PUBLIC COMMENTARY AND THE FINAL EIS

While accurate measurement of the effect of these public comments on the

final EIS is difficult, our analysis of Interior's published responses to these comments (Vol. IV) and our reviews of the EIS by disciplines indicates that the Department insufficiently used or considered public comments in the evolution of a sound oil shale program.

Many public comments on the draft were poorly interpreted, and evaluated inadequately discussed in the final EIS. In some statements pages were printed out of order. Commonly voiced concern among participants in the public review was that their comments and questions did not survive translation into Interior's analysis of public questions. (See Sections 4, 5-II-b on Program Alternatives and Wildlife.)

In an attempt to answer questions and comments without dealing with each comment separately in the final EIS, Interior constructed an index system of 143 topical categories. But in the process, many questions were rephrased or neglected completely. (IV-II and III). We have analyzed what we believe to have been important comments on the draft and have found many examples of neglect in the final EIS. One among these is the letter from Mrs. Doris Dawdy, in which she succinctly discussed the alternative of a government-operated strip mine on public oil shale lands. (Vol. V, letter #103). Her suggestions and additional questions regarding policy inconsistencies between Interior's preliminary draft and later draft were never addressed in the EIS; her written commentary was incorrectly indexed.

--"Adequacy of consideration of alternatives to selected tracts." (IV-II-14). Another example is from the Wyoming Department of Economic Planning and Development (IV-21-3), which submitted comments requesting that an emergency fund be established from royalties to cover certain unexpected environmental restoration activities. The request was not included in Interior's index, nor treated anywhere in the EIS.

A number of participants found that the substance of their questions had been lost in the process of referencing and indexing.* One politically sensitive letter was entirely omitted from the record. In a strongly worded letter, a member of the Colorado West Area Council of Governments had urged that leasing be delayed until the State-Regional studies were further along, to buy time for planning and preparation for the anticipated population growth in Garfield-Mesa-Rio Blanco counties area of Western Colorado. The letter was co-signed by another local planner representing the Oil Shale Regional Planning Commission (the organization leading the Regional Land Use Study for the State Subcommittee). It was not included in the EIS record, nor is there any indication in volumes I, III, or IV that the Regional Planning Organization had so strongly voiced its concern over the lockstep timing of the leasing program.

While the EIS does not ignore comments from the general public, it reveals substantial misinterpretation, misclassification, overgeneralization and inadequate followthrough for many of the most serious and substantive public review comments. This may have been caused partly by Interior's failure to separate extremely minor points in the comments from those of major importance.

No mechanism for response to public concerns seems to exist within the Department; if it exists its efficiency needs great improvement. One possible solution in this case might have been for the Department to have contracted with a recognized national environmental group to read, assort and establish priorities for the questions and comments presented by the public. This work could have supplemented the Department's own analysis of public comments.

The point to make here, of course, is that ways can be found to handle and analyze public comments once Interior acknowledges their positive, substantive, and

*Further analysis of the Comments Index (Vol. IV) reveals that 19 oral and 20 written statements were not referenced by Interior. Of these, 5 written and 11 oral statements raised substantial points entitled to consideration.

not simply political value to a given program. In the case of the oil shale EIS it is our judgment that legitimate and well-conceived public comments simply did not receive credible attention or affect the subsequent environmental analysis or the program statement in the final EIS.

VI. FUTURE PUBLIC PARTICIPATION IN THE OIL SHALE PROGRAM

There could be opportunities for future meaningful public participation in monitoring the program, carrying out the terms of the lease and evaluating the prototype. However, as is pointed out in Section 8 of this review (Legal Analysis), public participation aspects in the lease are weak. For example, development plans submitted by the lessees within three years of the issuance of the lease are subject to public hearings only if the Mining Supervisor deems it appropriate or necessary. There will also be established a Technical Advisory Board that will have as its main function the ability to advise the Interior administrators of the leasing program. (IV-I-15-17). Members of the public would only be observers of this advisory group, and only those people appointed by one of the State governors would be entitled to "participate."

VII. CONCLUSIONS

A. Review time for both the draft and the final EIS was insufficient to permit thorough public review and comments, despite some time extensions by the Department. No apparent attempt was made to match the permitted comment period with the complexity of the issue and the length of the material presented.

B. Public hearings presented no opportunity for the public to ask questions of, and enter into discussion with, federal experts on oil shale. Consequently the public had no opportunity to improve its capacity to make valuable comments later to the Department of the Interior.

C. The Department made no systematic attempt to separate the minor from the major points and questions presented by the public. Mechanisms to do so, such as the enlistment of help from recognized environmental groups, were not tried.

D. Analysis of important comments presented by the public indicates that the Department frequently neglected to answer or even to recognize the questions raised by the public and published in the EIS.

E. Future opportunities for public participation in the oil shale lease program are severely limited and in need of considerable expansion.

SECTION 7

STATE INPUT/COOPERATIVE STUDIES

I. INTRODUCTION

Early in the development of the oil shale program, the Secretary of the Interior requested the governors of Wyoming, Utah and Colorado to establish "oil shale panels" to provide "a means of program participation by various conservation groups, private enterprise, local governments, the public and universities." (IV-I-5). Such panels were formed in each state, and the one in Colorado prompted important environmental studies directly relevant to Interior's program.

In the public testimony concerning the Draft EIS, twelve reviewers asked that the leasing program be delayed until the Colorado state environmental studies are completed. Thirty-one reviewers asked that more studies and planning be done before leasing (IV-III-127). These responses indicate a high level of interest in the environmental studies and their potential implications. They also indicate that many people feel that the results of these studies should contribute to the decision on whether to proceed with the leasing program.

We include here an analysis of participation in the state studies by various interest groups because, although the EIS (IV-I-5) implies that wide participation was afforded to the public and to environmental groups, this was, in fact, not the case.

II. STUDIES BY THE THREE STATES

The three states affected by the proposed leasing of federal oil shale lands--Colorado, Utah and Wyoming-- published

reports concerning environmental problems in 1971.[1] These reports were compiled in an attempt to comply with a memorandum of May 28, 1970, to the Undersecretary of the Interior from the Assistant Secretary for Mineral Resources, Hollis M. Dole, and Assistant Secretary for Public Land Management, Harrison Loesch. The memorandum "directed" the states and the various federal agencies to prepare a report on a prototype oil shale development program in accordance with the provisions of Section 102 (2) (c) of the National Environmental Policy Act of 1969, Public Law 91-190, January 1, 1970.[2] These reports were used as a basis for much of Interior's first draft statement on oil shale issued in June 1971.[3]

The committees, in their reports, attempted to determine whether or not a federal leasing program could be initiated that would include adequate environmental safeguards and would answer questions about environmental impacts and their economic consequences for an oil shale industry.

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1. Colorado Governor's Oil Shale Advisory Committee, "Report on Economics of Environmental Protection for a Federal Oil Shale Leasing Program": Colorado Dept. Natural Resources, January 1971, 204 p.
Utah, The State of, Committee on Environmental Problems of Oil Shale, "Environmental Problems of Oil Shale": Utah Dept. Natural Resources, Feb. 19, 1971, 55 p.
Wyoming Oil Shale Environmental Planning Committee, Environmental and Economic Report on Wyoming Oil Shale": Wyoming Dept. Economic Planning and Development, Feb. 1971, 57 p.
2. Ibid., Wyoming, p. 1
3. U.S. Department of Interior, "Draft Environmental Impact Statement for the Prototype Oil Shale Leasing Program": June 1971, 69 p.

The Colorado report was critically reviewed by Roger P. Hansen,[4] a well-qualified environmentalist. His comments on the difficulties and shortcomings of the report are important to note:

> The Special Committee, in attempting to formulate answers to questions posed by the Interior Memorandum, was faced with an almost impossible task in view of established deadlines. While some answers could have been framed more appropriately if the right questions had been asked, the Special Committee was faced with a dearth of information in every environmental problem area. The result is that the report is weakened by a number of assumptions and hypothecations which may collapse after further scientific inquiry. Due to this considerable information gap, the value of doing the study at all within the restrictions imposed might be questioned, unless the study is considered only as a beginning, a first step. Once the studies which the Special Committee itself recommends are completed, the answers on the economics of environmental protection may possibly be quite different from those in this report. This could lead to considerable criticism of this study by those government agencies and industry leaders who may have become "locked in" to certain economic conclusions. [5]

The weakening assumptions and hypothecations were outlined thus:

> These premises are: (1) that an oil shale industry can, must and will be developed in the Piceance Creek Basin of Colorado in the near future to meet a national energy crisis; (2) that every forseeable type of environmental impact from an oil shale industry can be controlled, and controlled economically to make the project feasible; and (3) that the cumulative effects of numerous oil shale operations conducted simultaneously will probably be no more consequential in terms of environmental impact that one or two "model operations"; in fact, a discussion of cumulative effects which might conceivably outweigh economic benefits is omitted.[6]

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4. Hansen, Roger P., "A Critical Review of Report on Economics of Environmental Protection for a Federal Oil Shale Leasing Program": March 1, 1971, 20 p.
5. Ibid. p. 11
6. Ibid. p. 4

III. COMMITTEE MEMBERSHIP

Membership of the committees compiling the reports was drawn primarily from those sectors which could be expected to derive direct economic benefits from oil shale development -- first from the oil and mining industries and consultants to those industries, and also from state and federal agencies that are charged with aiding oil and mineral development either directly through promotion or indirectly through leasing or sale of state and federal lands, regulation, research and resource appraisal.[7] No representatives from local government, citizen conservation organizations, private environmental consulting firms or the public at large were on the state committees.

	Membership of State Committees Who Compiled Reports		
	Colorado	Utah	Wyoming
Industry or trade organization	6	3	1
Federal agencies	4	1	3
Industrial consultants	2	0	2
State agencies	1	7	11
University	1	1	2
Total	14	12	19

Note: Op. cit., Colorado, p. 3; Utah, p.4; Wyoming, p. 2.

All three State reports recommended courses of action for the state and the federal government. The Colorado Committee recommended that a joint advisory committee be established composed of members of Interior's Oil Shale Task Force and representatives of state and local agencies, industry and conservation groups. Further, it recommended that this joint committee should conduct

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7. This author determined that the state and federal agencies so charged made up 4 of the 5 agencies represented on the Colorado

special studies to include underground water, surface water, wildlife and vegetation, regional development and an environmental impact study by an independent conservation organization "in order to supplement existing knowledge in important areas of concern."[8]

IV. THE COLORADO STUDIES

In April 1971 the Colorado Committee was reformed and expanded as the Governor's Committee on Oil Shale Environmental Problems. The committee was charged with the responsibility of designing the studies and recommendations that would provide a good basis for planning environmental protection in the event of oil shale development in Colorado. This committee undertook four studies to be jointly funded by the State of Colorado, local government, the Department of the Interior and private oil companies. The studies are scheduled to end by the summer of 1974 at a total cost of $715,000. They are overseen by four steering subcommittees with a membership of 4 or 5 persons each.

The general objective of the studies is two-fold: 1) to determine what environmental and resource information is currently available and to conduct investigations and field studies to gather additional data; and 2) to analyze and assess the impacts

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committee, 6 of 8 on the Utah committee, and at least 5 of the 11 on the Wyoming committee.
8. Op. cit. Colorado, p. 201 ff.

of oil shale development for use in the decision-making process[9] and suggest methods to minimize or avoid undesirable environmental impacts.[10] This information is to be presented in report form. These studies will provide the framework for recommending environmental quality standards for the state of Colorado.

The Committee on Oil Shale Environmental Problems was divided into four subcommittees to correspond with the four studies shown below:

Study	Contractor	Cost
Revegetation and surface rehabilitation	Colo. State Univ.	$130,000
Water resource management	U.S. Geol. Survey	280,000
Environmental inventory and impact	Thorne Ecological Institute	160,000
Regional development & land use planning	Colorado West Area[11] Council of Governments & Oil Shale Regional Planning Commission	145,000

The first reports now published or printed are literature surveys for the most part and are compilations of previously available material. The unpublished reports are based on new field data or data gathered since 1971, and these give interpretations of data and recommendations for planning and resource use. Each of the four state subcommittees on environmental studies is drafting a final report which concludes its 1971 work plan. The final

9. Thorne Ecological Institute, "Environmental Inventory and Impact Study, Draft." July 6, 1972, p. 2
10. Thorne Ecological Institute, "Outline of Proposal for Environmental Inventory and Impact Study." No date, p. 5
11. Parts of the study are subcontracted to the Denver Research Institute, Industrial Economics Division, THK Associates of Denver, and Bickert, Browne and Coddington of Denver

reports of the Colorado Subcommittee on Regional Development and Land Use Planning due in December 1974 will be a synthesis and a planning summary. All four study contractors have completed reports on the work in progress and these are described in the following section.

V. COMPLETED REPORTS

1. "Revegetation and Surface Rehabilitation Studies--First Interim Report:" Colorado State University, Nov. 15, 1972.

This is a review and compilation of previous literature and contains sections on such subjects as water requirements, mining, technology, soils, geomorphology, and adaptability of plant species. It outlines the conduct of phase 2 of the study as field trials of revegation and rehabilitation under actual conditions.

2. Ficke, John F., Weeks, John B., and Welder, Frank A., "Hydrologic Data from the Piceance Basin, Colorado." (Unpublished)

The report is a compilation of extensive data from field investigations done since 1971 and from the literature on the surface and ground water quality and quantity of the oil shale area. This report was completed in March 1973 but is unavailable outside the Water Resources Division, U.S. Geological Survey. It has not been cleared for publication by John Riggs, Deputy Assistant Secretary of Interior.

3. Thorne Ecological Institute, "Regional Oil Shale Study--Phase I, Part I:" May 7, 1973.

This is a review of the literature and a compilation of information from field reconnaisances. The study is broken into investigations of major ecological components; the investigator

in each discipline worked independently.

4.a. Gilmore, Johnson S., and Duff, Mary K., "The Oil Shale Regional Economic Base--Working Paper #1:" Denver Research Institute, January 3, 1971.

The report examines the existing economic relationship in the three county oil shale area and forecasts the employment, personal income and population level to 1987 if no oil shale development were to occur. The methodology for obtaining these forecasts is described.

b. Prien, Charles H., Schantz, John J. Jr., Doran, Richard K., "Profile of Development of an Oil Shale Industry in Colorado--Working Paper #2:" Denver Research Institute, February 1973.

The report uses Department of Interior data to describe two profiles of successful oil shale development by 1987: 1) moderate success of 400,000 barrels per day production, and 2) maximum success of 750,000 barrels per day production. It focuses on identifying the impacts of each development profile, the requirements or inputs from the communities necessary to development, and the outputs--oil and by-products, salaries, taxes, royalties, pollution--resulting from development.

c. Gilmore, John S., and Duff, Mary K., "Impact Analysis and Development Patterns--Working Paper #3: Denver Research Institute, July 1973 (Review draft).

This report examines the impact on the three county area economy from the two profiles of oil shale development in Working Paper #2. It includes discussion of the increases in population, personal income and requirements for housing and public services.

An agenda for local government planning and decision-making to deal with the impacts of these two development profiles is described.

All four subcommittees have reports in progress which will be interpretative analyses of the potential impacts from oil shale development. These later reports are crucial elements in the State study program.

VI. AVAILABILITY OF REPORTS

The reports published were printed in limited amounts and are unavailable to the general public through purchase. The water resources report is being kept confidential, but the other reports are not. The latter can be borrowed, although an interested person would have to be quite familiar with the studies to know that the reports exist. This author reviewed a file of oil shale clippings from Colorado newspapers and found no public method of publication.

VII. EVALUATION OF THE STATE STUDIES

Reviews of the state studies in progress by people on the subcommittees or involved in the work provide a variety or reactions to it. Most evaluations indicate the contractors were doing a competent job within the limitations of time and money imposed on them. The state studies are viewed as a necessary first step in gathering general baseline data essential for delineating and predicting environmental impact.

Criticism of the revegetation studies was voiced because of the short duration of the work; the state revegetation studies are supported only through December, 1974. One worker elaborated, "the

real unknown is revegetating the spent shale material... The studies by private industry have not proven much with regard to stabilizing spent shale and establishing vegetative cover that will survive under natural conditions and thru the vicissitudes of climate. They have proven primarily that the TOSCO spent shale is not toxic to plants as long as you leach out the salts, irrigate, and fertilize; then you can grow certain plants on it."

There appears to have been no coordination between the information gathered by the state studies and that gathered by the EIS writers. In a few cases the authors of the EIS had special knowledge of the state data.

One very significant revision of the draft EIS involved ground water data. Ground water in the Piceance Basin of Colorado was estimated to be 2.5 million acre feet in the Draft EIS (I-II-23) but was revised upward to 25 million acre feet in the Final (I-II-48). The derivation of the revised estimate is not referenced. Such a calculated estimate could only come from an extensive ground water survey such as that carried out by the USGS in cooperation with the state of Colorado as a part of the state studies. And yet, even now the basic data from the study has not been released to the public.

Would the results of the state studies have affected the design of the Oil Shale Program if they had been available in time? Responding to this question in the author's survey of state study workers, one subcommittee member believed that with respect to regional development and land use planning the state studies should have had some relationship to the planning of the federal program. They did not, however, primarily because the

federal program moved so swiftly. Now that the information is at hand he has recommended that the tracts be reselected and the EIS rewritten. Reselection of the tracts would be done to ensure that the population centers that will grow as a result of oil shale will be in the same county as the leased tracts; otherwise (as noted in section 5, part III of this review) the taxes paid by the industry will not increase the tax base where the influx of people and the need for services will be.

With respect to environmental inventory information gathered in the study, workers generally felt that the new ground water data would be the most significant in terms of providing new perspective on the federal program, especially on the particular tracts selected. Most comments indicated that the Interior program could have been better designed if such data had been available earlier, or if there had been, and were now, more planned liaison between the state and the Interior Department.

The most important response came with regard to the potential contribution of these state studies to the Secretary's informed decision on the prototype program at this stage; workers familiar with the various state and cooperative studies indicate that new baseline data not incorporated in the EIS could be very helpful to the Secretary in evaluating the proposed Program.

VIII. CONCLUSIONS

1. The Environmental Studies conducted by the state (Governor's Oil Shale Committee on Environmental Problems) in Colorado were planned and funded during 1971 for the purpose of

carrying out studies to gather and evaluate basic data concerning oil shale development. These were to be of use to government bodies and the private sector. These data will be essential to the design and conduct of the federal program.

2. Since the Colorado oil shale areas are richest in shale oil and have the best chances of receiving bids, it is particularly important that its environmental problems are evaluated carefully.

3. It appears probable that Interior, industry and the public will not have access to these data before the lease terms are completed and before a decision on the program by the Secretary of Interior since the unpublished state study reports will not be available or complete until the summer of 1974. Final reports of three Colorado subcommittees will be followed by a fourth synthesis and planning report, which is expected in December, 1974.

5. The EIS makes no pretense of determining the relevance or value of the state environmental studies to the federal evaluation of the oil shale program. The importance of any new data to be forthcoming from these state studies is never examined within the EIS, and no analysis has been made of the benefits gained from postponing leasing until after completion of these studies. Instead, the EIS notes simply that study results will be "available for each lessee to incorporate into his detailed plans for development prior to physical development of the resource itself." (IV-III-130). Possible modifications of lease terms and new tract selection have been totally neglected as alternatives.

SECTION 8

LEGAL ANALYSIS

I. POLICY CONFLICTS

A. Introduction

The decision to develop oil shale requires certain broad policy choices. The major justification for a federal oil shale leasing program is to stimulate private enterprise to develop an oil shale industry on private and public land so as to help meet the nation's demands for energy. Accompanying oil shale development will be environmental impacts of great magnitude. Impacts would include those on the land itself, on water resources and air quality, on fish and wildlife habitat, on grazing and agricultural activities, on recreation and aesthetic values and on existing social and economic patterns. A decision to initiate a federal leasing program, therefore, involves trade-offs between competing public policies of meeting energy demands and protecting the environment. A major task of the EIS is to present these conflicts to decision-makers and to the general public as precisely and clearly as possible. The purpose of this discussion is to highlight those policy and legal conflicts posed by the oil shale leasing program that were not clearly disclosed and analysed in the EIS either in the sections on environmental impact or on alternatives.

B. Water Quality

1. Salinity

The federal oil shale leasing program is intended to spur the development of a prototype industry, which would have great impact on the quality of the region's waters. Potentially the most severe impact of oil shale development in this area is a significant increase in the salinity concentration of the Colorado River. The EIS indicates that at the 1 million barrel per day level of oil shale development, the industry and associated urbanization will require, for consumptive use, between 121,000 and 189,000 acre feet of water per year from surface water supplies. (I-III-35 and I-III-76) The EIS states, however, that "the actual amount of surface water that will be made available to support oil shale development is unknown." (I-III-69)

Anticipated increases in salinity levels, sedimentation loads, heavy metals, and toxic materials will significantly impair any future use of the water within the three-state region and downstream. The results of these actions are in direct conflict with the stated goals and objectives of the 1972 Amendments to the Federal Water Pollution Control Act. (FWPCA, 33 U.S.C. Sec. 1151 et seq.) The act states:

> The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. In order to achieve this objective, it is hereby declared that, consistent with the provisions of this Act -- (1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985; (Section 101(a))

Salinity levels at Hoover Dam, a key point in the Colorado River system, are predicted to increase by about 10 to 15 milligrams

per liter, from 760 to 770 to 775 milligrams per liter. (I-III-76). This is caused by the taking of water from the Colorado River system that thereby reduces its salt dilution capability. Salt concentrations could be greater if oil shale development added dissolved solids to the Colorado River through return flows resulting from reinjection of water into the leached zone (forcing the saline water into surface systems), leaching of shale disposal piles or accidental release of saline mine waters. (I-III-76,77. And see section 5 of this review on Hydrology.)

The salinity increase in the Colorado River caused by oil shale development conflicts with the water pollution policy of Colorado. The Colorado Water Quality Control Act, CRS 66-28-102 (1973 Sess. laws) states

> (1) It is hereby declared that pollution of state waters constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife and aquatic life, and impairs domestic, agricultural, industrial, recreational, and other beneficial uses of state waters...

The Act prohibits degradation of the state's waters.

2. Other Water Pollution Aspects

In addition to the conflict between predicted salinity levels and legal requirements, the 1972 FWPCA Amendments have other important implications with respect to the proposed oil shale program. The EIS does not include discussion of the legal requirement to apply and obtain (prior to construction) a Permit to Discharge waste-water. Similarly, no provisions are discussed for controlling, monitoring, and upgrading both point-sources and non-point sources of discharges. Again, this conflicts with the

statutory mandates inherent in the 1972 Amendments.

It is noted in the EIS that the increased ancillary facilities required to support the one million barrel per day industry (such as municipalities, power generating facilities, holding ponds, etc.) will "result in widely scattered local point sources which are difficult to control." (I-III-94) But the EIS then neglects to discuss the ways and means by which current waste-water disposal technologies could be implemented to assist in controlling these point sources of discharge.

The EIS is deficient generally in its discussion of water quality effects of oil shale development, particularly with respect to the 1972 Amendments. To sum up:

a. There is no attempt to identify and quantify point and non-point sources, even though this is a major goal of the Amendments.

b. Water quality impacts are not discussed in the EIS with respect to their legality.

c. There is no discussion of the process of obtaining discharge permits, although this will be an integral part of the pre-construction stage.

d. Leaching of minerals from spent shale is mentioned in the EIS as a potential water quality problem. ("Runoff of rainwater or melted snow from the disposal site would leach the spent shale to indeterminate depths." I-III-84) Is this a direct violation of the 1972 Amendments, which state that all non-point sources (such as leaching fields) must be identified and controlled?

The point is not discussed in the EIS.

e. Monitoring levels required by the Amendments are similarly not discussed.

f. The EIS does not deal specifically with the methods of treating, recycling and/or disposing of process water after use. There could be serious pollution if discharge into surface water-ways is contemplated.

g. The general policy goals of the 1972 Amendments appear inconsistent with the proposed development of oil shale and a decline in water quality may be an inevitable result of the program. This issue is neglected in the EIS.

C. AIR QUALITY

Development of a prototype oil shale industry may pose other conflicts with the national policy of protection and preservation of air quality from significant degradation. This policy stems from the National Environmental Policy Act, Executive Order 11514, the Federal Clean Air Act and the National Ambient Air Quality Standards.

The National Ambient Air Quality Standards promulgated by EPA under the Clean Air Act include the following provision designed to protect and enhance air quality:

> The promulgation of national primary and secondary ambient air quality standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of any state. 40 C.F.R. 50.2 (c)

In addition, Fri v. Sierra Club, __U.S.__ ; 5 ERC 1417 (1973) affirmed the U.S. Court of Appeals decision that the Clean Air Act prohibits the Administrator of the EPA from approving any state plan implementing the National Ambient Air Quality Standards that allows significant deterioration of the existing air quality in any portion of any state. As of this writing, the Administrator is in the process of promulgating a definition of the key term "significant." On the basis of information provided in the EIS, and as this review notes (see 5-I-B), the air pollution resulting from the oil shale program may well be "significant." Under these circumstances, the EIS should certainly discuss what steps might be taken by the federal government and/or an oil shale lessee to meet the dictates of the Clean Air Act under several different definitions of the term "significant."

Besides potential violations of the federal policy of clean air, the prototype oil shale program may also violate the policy of Colorado to prevent air quality degradation.

> It is hereby declared to be the policy of the State of Colorado that in those areas where existing air quality is better than ambient air quality standards, such existing air quality will be protected and significant degradation of Colorado's air resource will be prevented.

There is no evidence in the EIS that these air standards will be met. On the contrary, a prototype oil shale industry using internal heat retorting processes could not meet Colorado's 1980 SO_2 emission standards with presently available control technology. (I-III-148). A retorting process using the indirect heat method can meet this standard only with 90 percent or greater sulfur removal from the flue gases. (I-III-147). This technology is not available, however.

Because of lack of data in the EIS (see section 5 of this review on Air) there is no reason to believe that any ambient air quality standards can be met, even without a non-degradation requirement. In this event the EIS seems to suggest that the oil shale industry may seek to obtain variances, available,for example, under Colorado regulations, to exceed the SO_2 standards, leading to new legal questions under federal law.

D. WILDLIFE PROTECTION

Development of a prototype oil shale industry would apparently conflict with the national policy of protection of wildlife, including endangered species and wild horses. This policy is articulated in the Endangered Species Conservation Act of 1969 (16 U.S.C. Sec. 668 aa - 668cc - 6), the Bald Eagle Protection Act (16 U.S.C. Sec. 668-668d), the Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661-667e), and the Wild Horses and Burros Act (16 U.S.C. Sec. 1331).

The Endangered Species Conservation Act 1969 provides that the:

> Secretary of the Interior together with the heads of bureaus, agencies, and services within (his) department shall seek to protect species of native fish and wildlife, including migratory birds, that are threatened with extinction, and, in so far as practicable and consistent with the primary purposes of such bureaus, agencies, and services, shall preserve the habitats of such threatened species on lands under (his) jurisdiction. 16 U.S.C. 668aa.

The United States List of Endangered Native Fish and Wildlife includes species which occur on the proposed lease tracts. The Environmental Impact Statement states that there are bald eagles on Utah tract U-a and U-b. (III-IV-114). Also, according to observations by conservationists, bald eagles are present on Colorado site C-a.

Peregrine falcon exist on Wyoming tracts W-a and W-b and on or in the vicinity of Colorado tracts C-a and C-b. (III-IV-109,111). The endangered Colorado River squawfish occurs in the White River near Utah tracts U-a and U-b. (III-IV-114, 115).

The Endangered Species Conservation Act apparently requires

the Secretary to plan oil shale development by considering alternatives that would minimize damage to any endangered species. Lack of special attention to endangered species in the EIS and in the tract selection process, without explicit reference to obligations under the Endangered Species Conservation Act, deprives decision-makers such as the Secretary of Interior of important facts and policy considerations. The proposed lease also does not require that the lessees inventory the tract for peregrine falcon and bald eagle to best determine a development plan. Such a provision might prevent disturbance of nesting sites. The lease could also regulate any aircraft flights associated with the tract so as to minimize disturbance to the birds and could specifically regulate construction of power lines to avoid the electrocution of bald eagles.

Under the Wild Horses and Burros Act the Secretary of Interior is directed "to protect and manage wild free-roaming horses and burros as components of the public lands," and to "manage wild free-roaming horses and burros in a manner that is designed to achieve and maintain a thriving natural ecological balance on the public lands." 16 U.S.C. Sec. 1633.

Wild horses occur on tracts C-a, W-a and W-b. (III-IV-104, III-II-113). Protection could be afforded by provisions in the lease, but this has not been done. The lease could require the mining plan to take cognizance of key areas for wild horses on the tract and to enumerate measures to avoid disturbance of the horses. It could specifically provide against harrassment.

E. MATURE INDUSTRY IMPACT

The EIS fails to discuss the environmental impact of a mature oil shale industry. It restricts discussion to a one million barrel per day industry by 1985*, supplied by industry on the proposed six public tracts (250,000 barrels per day) and the balance from private lands and from further leasing on public lands. (I-III-6) Therefore, the decision-making public has little grasp of the environmental consequences of a mature commercial industry to which the present leasing program may lead.

The federal leasing program is legally and conceptually similar to the Atomic Energy Commission's Liquid Metal Fast Breeder Reactor program (LMFBR); both programs are in the research and development stage that may well lead to widespread use of particular technologies that in turn may preclude (because of the great capital investment required) future considerations of energy producing alternatives. Scientists Institute for Public Information, Inc. v. Atomic Energy Commission, et al., 5 ERC 1418 (D.C. Cir. 1973) indicates that Interior must prepare an Environmental Impact Statement describing the impact of a mature oil shale industry as soon as it would be meaningful to do so.

In this case, the court noted that:

> To wait until a technology attains the state of complete commercial feasability before considering the possible adverse environmental effects attendant upon ultimate application of the technology will ultimately frustrate meaningful consideration and balancing of environmental costs against economic and other benefits. Modern technological advances typically stem from massive investments in research and development, as is the case here. Technological advances are therefore capital investments and, as such, once brought to a stage of commercial feasability, the investment in their development acts

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*Even this EIS assessment of one million barrels per day is inconsistent. See p. 120 of this review.

> to compel their application. Once there has been, in the terms of NEPA, 'an irretrievable commitment of resources' in the technology development stage, the balance of environmental costs and economic and other benefits shifts in favor of ultimate application of the technology. . . because of the long lead times necessary for development of new commercially feasible technologies of production of electrical energy, the decisions our society makes today as to the direction of research and development will determine what technologies are available 10, 20 or 30 years hence when we must supply some new means of producing electrical energy . . . The manner in which we divide our limited research and development dollars today among various promising technologies in effect today, determines which technologies will be available and what type and amount of environmental effects will have to be endured in the future when we must apply some new technology to meet projected energy demand.

The court addressed the issue of when a statement on the overall project should be completed. It felt that the statement need not be made part of the Enfironmental Impact Statement on an individual component. The court recognized that:

> Statements must be written late enough in the development process to contain meaningful information, but must be written early enough so that whatever information is contained can practically serve as an imput into the decisionmaking process. . . Some balance must be struck, and several factors should be weighed in the balance. How likely is the technology to prove commercially feasible, and how soon will that occur? To what extent is meaningful information presently available on the effects of application of the technology and of alternatives and effects? To what extent are irretrieveable commitments being made and operations precluded as the development programs progresses? How severe will be the environmental effects if the technology does prove commercially feasible?

Application of these four factors to oil shale development indicates that an impact statment for a mature oil shale industry is appropriate at this time. Not only could development of alternate energy sources and technologies be foreclosed by the oil shale

program, but also, improved technologies for oil shale development itself might effectively be "locked out." Given the oft-stated need to develop comprehensive national energy policies, the legal mandates under the National Environmental Policy Act and the potential energy policy utility of a detailed EIS on long-range, large-scale oil shale operations, it is unclear why the Department neglected the programmatic approach in this EIS.

F. ALTERNATIVES

Another defect in the Environmental Impact Statement is that the statement considers alternatives to a one million barrel per day industry by 1985, whereas the proposed Prototype Leasing Program will produce only 250,000 barrels per day (b/d) by 1985. (III-IX-2,3). By this kind of analysis, alternatives to shale must yield more than is planned for the Prototype Program. Such analysis is valid only if it can be said that if there is no Federal Leasing Program, there will be little or no ensuing production on private lands. (The EIS speculates that the proposed program will stimulate production of 400,000 b/d by 1985.) Why private development would not occur without Federal leasing is only hypothesized in the EIS. (III-IX-24).

Another basic flaw in the analytical approach taken in this part of the EIS is that each energy alternative is examined as to whether it can alone produce a total alternative to oil shale. For modification of Federal Power Commission natural gas pricing, the Environmental Impact Statement states that "...it is not considered to be substitution that could be utilized to totally offset a major portion of shale oil supplies." (emphasis added). (II-V-40). For outer continental shelf production, the EIS emphasizes the various uncertainties as to whether this source could produce beyond the projected amount and goes on to conclude that "with these uncertainties there is a real possibility that production resulting in further increased leasing schedules would not be able to completely offset the projected shale oil development." (emphasis added). (II-V-46). Similar total solutions are required of onshore

oil production, II-V-62; liquified natural gas, II-V-97; coal, II-V-103; coal conversion, II-V-130; nuclear power plants, II-V-144; tar sands, II-V-157; and hydroelectric power, II-V-167 and other alternatives (see section 4 of this review).

G. COST-BENEFIT ANALYSIS OF ALTERNATIVES

The EIS reveals that there are many possible sources of energy which could substitute for oil shale in order to increase U.S. energy production. Detailed descriptions of the environmental impacts of these possible alternatives are presented in the EIS, but any analysis of the relative impacts of the various technologies or sources is lacking. There is no determination of a Btu/environmental impact ratio that might be based on such factors as water, air and land use for each alternative or combination of alternatives. Decision makers are presented with a proposed oil shale leasing program and with many alternatives. Without some means of weighing these options proper decisions on how to develop energy with the least environmental impact becomes necessarily difficult.

H. CONCLUSIONS

1). The Prototype Oil Shale Program presents a conflict between the demand for energy and the national policies favoring and/or requiring protection of water, air and wildlife. The potentially significant environmental effects of these conflicts and the possible legal violations that may arise from the oil shale program are not recognized and analysed in the EIS.

2). Initiating the proposed oil shale program may preclude or delay development of relatively clean energy sources, such as solar energy, simply because important industrial investment capital will be tied up in oil shale. This possibility was not analysed in the EIS.

3). The EIS does not include a discussion of the potentially significant environmental impact of a mature commercial oil shale industry, despite provisions in the lease terms and other statements in the EIS that suggest encouragement of such a mature industry.

4). The discussion of alternatives is based on the need to provide alternatives to a 1 million barrel per day industry, rather than a 250,000 barrel per day industry as proposed by the EIS.

5). The EIS discussion of alternatives to the oil shale program does not present means to assess whether there is less environmental impact from various alternatives. Cost-benefit analysis, which can be a useful aid to this balancing process, was not employed in the EIS.

II. LEASE ANALYSIS

A. Introduction

Throughout the EIS references are made to the environmental protection measures that will be assured by the oil shale lease provisions (included as an integral part of the EIS in Volume V-3 to 93). Consequently, an assessment of the EIS must include examination of the lease. In making this examination, however, it is evident that the lease, while replete with important guidelines, has significant gaps. Most particularly, the lease relies especially on the provisions of a detailed development plan to be presented, after the lease has been granted, by the lessee to the Mining Supervisor of the U.S.G.S. It is apparant that the environmental effects of the proposed leasing arrangement can be substantial and may be different from those forecasts presented elsewhere in the analytical sections of the EIS.

In the discussion of these effects below, two principle points should be borne in mind: 1) it is the task of the EIS systematically to describe the most likely environmental impacts of a proposed program including the effects of any proposed regulatory mechanisms, and 2) the EIS examination of alternative programs should logically include the analysis of the effects of significant regulatory variations. To omit this kind of analysis is to inhibit the logical inquiry of the decision-maker and the general public into the forseeable consequences of a proposed action.

B. Environmental Protection Criteria

The absence of environmental quality standards by which to

judge the lessee's lease compliance was not discussed in the EIS. This review has already noted that the revegetation goals of the lease, which are specific, do not in fact assure lessee compliance because of its many contingency clauses (see section 5-II-A of this review). In the matters of air, water and tailing disposal, the lease could also be more specific and effective in assuring environmental protection. Thus, the lease might specify that all, or some lesser percentage, of waste materials be disposed of within the mine itself. The EIS lease, however, requires no underground waste disposal.

Similarly, the lease could eliminate vague terminology, as evidenced by the following provision: "The Lessee shall avoid, or where avoidance is impracticable, minimize and, where practicable, repair damage to the environment, including the land, the water and the air." (III-V-27.) The environmental implications of these permissive terms has not been considered in the EIS.

C. Mining Supervisor Authority

The most notable administrative feature of the lease form is the provision for the traditional, primary role of the Mining Supervisor. As is the case in the most routine mining operations, it is he who grants variances, reviews roads and utility plans, and (after certain minimum periods) can terminate the environmental monitoring system. Wildlife management plans, habitat protection schemes, use of pesticides and herbicides and water degradation standards (in the absence of state and federal determinations) are all within the discretionary control of the Mining Supervisor.

Most importantly, the Mining Supervisor approves the detailed development plan submitted by the lessee, without the benefit of detailed criteria in the lease. All of this authority is given to the Mining Supervisor despite his lack of ecological expertise.

Clearly the practical environmental implications of these significant powers of the Mining Supervisor can and therefore should be assessed in the EIS. Yet no Interior analysis, other than two paragraphs of response to comments (IV-III-172), was made of this leasing arrangement. In fact, the EIS appears more concerned about the lessee than the public. Thus it states: "It is considered preferable that the operator have one responsible Interior official to deal with in regard to the resources and management of these specific leased lands." (IV-III-172.)

D. Regulation by the Environmental Protection Agency

Among the most promising but neglected alternatives for Interior to consider in the EIS, in terms of environmental effectiveness, is the separation of Interior's promotional role from its proposed regulatory role. The Environmental Protection Agency could certainly be placed in charge of all environmental monitoring and protection schemes that the Mining Supervisor now controls.

Monitoring of air and water pollution could certainly be taken out of the hands of the lessee himself as part of a general policy to eliminate self-policing measures where environmental protection schemes are the most critical. Such a course would be directly contrary to the announced EIS preference for lessee self-regulation.

The EIS, in fact, did not analyse any other course. It simply states (IV-III-174) that EPA monitoring is on a "broader scale," ignoring that agency's experimental interests and legislative mandate, and notes that "...the responsibility to comply lies with the lessee, and it will become essential that he monitor his own activities to insure compliance." (IV-III-174, emphasis added).

E. Public Participation

1. Mandatory public hearings

The critical importance of the detailed development plan, which becomes the focal point of so many environmental assurances presented in the EIS, suggests that mandatory public hearings 90 days after submission of a plan would help guarantee adoption of sound environmental protection measures. Another alternative might be to require an EIS by Interior on each development plan. If a significant degree of environmental protection would be added by such actions, as appears likely, then this oil shale EIS should assess them.

2. Public Advisory Board

For the same reason, the EIS analysis can extend to other public participation opportunities, as, for example, when variances are considered under the lease, or revegetation technology is assessed. The utility of public advisory boards can be appropriately considered here. This has not been done. As noted in this review (see Section 9) the Technical Advisory Board arrangement, may meet some program needs but does not encourage public participation in any way.

3. Public Information Policy

Alternative policies on the public availability of information gathered by the lessee also have direct environmental implications. Lessee records on the quantity and quality of the oil shale mined (III-V-18), baseline information, annual progress reports and other non-patentable information can all be made available to the public as a means to insure broad environmental assessment of the experimental technology being encouraged by the federal

F. Analysis of Major Lease Terms

The EIS lease is replete with provisions likely to have significant environmental effects. Among the principal provisions not analyses for effect or for alternatives are:

1. Provisions authorizing the lessee to "credit against any minimum royalty due" on the 6th to 10th anniversary dates "any expenditures" made between development plan approval and the 10th anniversary that are "directly attributable to operations on the leased lands pursuant to the development plan." What is the environmental rationale for this provision?

2. Federal subsidies for lessees who have sought to obtain revegetation technology in a "diligent" manner and expended over $500,000 in the effort. Why is a subsidy required and why is $500,000 the limit?

3. The twenty-year lease term extendable if commercial quantities are produced. How does this provision meet the goals of an experimental program?

4. The reclamation bond of $2000 per acre (for mining and spent shale lands) and $500 per acre (for other disturbed lands). How were the bonds calculated and why is there no minimum bond after three years of operation?

In addition to these provisions, questions arise regarding the Mine Supervisor's determination of lease violations and violations of federal and state air and water standards. Uncertainty regarding the definition of non-degradation laws and potential conflicts between them and the lease itself make this a critical question with substantial environmental quality implications.

G. Conclusions

1. Assurances of environmental protection in the EIS depend largely on lease provisions, which, however, have significant gaps likely to adversely affect the environmental quality of the oil shale region.

2. The EIS did not systematically examine the implications of alternatives to the proposed lease arrangements.

3. Environmental protection provisions in the lease lack specificity and criteria by which the federal government can judge and regulate operations of the lessee likely to have a significant environmental effect.

4. The EIS lease provides for the traditional broad discretion of the Mining Supervisor employed in non-experimental mining situations, but the EIS does not analyse the environmental implications of his powers, despite problems of a lack of relevant expertise and the omission of strong environmental criteria in the lease.

5. Separation of Interior's promotional function in the oil shale program from its regulatory role was not examined in the EIS. Instead, the EIS dismissed without analysis the suggestion that the Environmental Protection Agency assume control over all environmental monitoring and analysis.

6. The value of public participation in ensuring environmental protection was not evaluated in the EIS. Neither mandatory public hearings nor mechanisms for meaningful public participation in critical regulatory determinations were discussed.

7. The EIS did not examine alternative public information policies by which information and reports of lessees relevant to environmental protection could be made publicly available.

8. Various critical lease provisions, such as those on lessee deductions from royalties for "extraordinary" environmental costs, lease terms, and bond amounts were not evaluated for environmental effects and alternatives.

SECTION 9

RECOMMENDATIONS*

I. POLICY RECOMMENDATION

Based on a scientific critique of the EIS for the proposed oil shale leasing program of the Department of Interior, the review team recommends to the Secretary that the proposed program not be approved at this time.

Serious deficiencies in the program design and in the environmental analysis indicate that proceeding with the program as proposed would entail undesirable and unnecessary risks to the government, the public, and the human and natural environment.

In particular:

--Despite significant deficiencies in the EIS, it appears from the information outlined therein that the anticipated environmental impacts of the proposed program are severe enough to outweigh any potential benefits. Unsolved problems such as revegetation, waste disposal, and social and economic impacts are of such great magnitude that a large-scale prototype program is clearly premature.

--For reasons outlined in the conclusions and body of this review, the proposed program has not been founded on sound principles of experimental design, nor on a thorough examination of alternatives to the program and other energy options. In addition, the goal of environmental quality has not been sought in the analysis or in the lease itself.

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*It is not the purpose and policy of the Environmental Impact Assessment Project to recommend or endorse particular policy positions. However, on completion of its analysis, the oil shale EIS review team developed and felt strongly about the recommendations included here. They are hereby submitted to the Secretary of the Interior for his consideration. These recommendations will also be sent to the Board of Trustees of The Institute of Ecology for its consideration.

II. LEASE DESIGN RECOMMENDATIONS

If a program similar to the prototype oil shale program discussed in the EIS is to proceed, despite the policy recommendation of the review team, it is imperative that the leasing procedure and the lease document itself be revised to include strong sanctions to protect the environment. The following recommendations are made with respect to the necessity of redesigning the lease. (For further analysis of the proposed lease, see section 8II of this review.)

Recommendations in this section cover the necessity for evaluation and review before the leasing of large tracts, independent environmental monitoring, government research, and the establishment and enforcement of environmental standards. The present proposed lease is deficient in all of these areas. If these suggestions are not implemented in a revised lease, the team recommends that the program should by no means proceed.

1. Three-step leasing procedure: In order to insure adequate environmental protection in an oil shale leasing program, the issuance of a final lease should be dependent on the following three steps:

a. A preliminary, short-term lease should be let in order for each lessee to prepare a "detailed development plan" for his tract. Exploration, groundwater pumping, test drilling, revegetation studies and other preparatory work could be performed. Periodic reports of information obtained should be made public.

b. An environmental statement under NEPA should be prepared prior to the issuance of a final lease for the development of each tract. This statement would be based on information gained in step a.

c. A decision as to whether to issue a final lease for development of each tract would be based on the NEPA process, step b.

2. Review of site selection: The specific sites to be included in the leasing program should be reviewed. Revised selections should be made on the basis of:

a. environmental considerations, including groundwater characteristics and values such as wildlife habitat;

b. diverse characteristics, providing opportunities to compare technologies (but within the criterion outlined in a. above);

c. smaller tracts (smaller than the proposed 5120-acre tracts), enhancing the experimental nature of the program.

3. Independent monitoring: Environmental parameters in both the preliminary and final lease phases should be monitored as follows:

a. The Environmental Protection Agency (EPA) should design and coordinate monitoring activities.

b. The lessees should pay the costs of environmental monitoring.

c. The U.S. Geological Survey (USGS) should be responsible, under the coordination of EPA, to monitor, analyze and report on the uses of water, water quality changes, groundwater quality changes, groundwater use and changes in piezometric levels. This would require gaging stations and water quality stations to record changes resulting from oil shale operations.

d. The Soil Conservation Service (SCS) and the U.S. Forest Service (USFS) should, under the coordination of EPA, design, oversee, monitor and evaluate a prototype revegetation program during

the preliminary lease phase. This comprehensive research program would include determination of appropriate species and ecotypes and their requirements and continuous monitoring of soil minerals (with emphasis on the problem of sodium salts). This work would relate to revegetation on both disturbed soil and spent shale. The SCS and USFS should also monitor revegetation during the final lease phase, under the coordination of EPA.

4. Establishment and enforcement of environmental standards: The terms of both the preliminary and final leases should specify outside limits on environmental degradation consistent with all applicable environmental quality statutes, such as the federal Clean Air Act and Water Pollution Control Act (with 1972 Amendments). In particular, salt discharges into water-ways should be limited in the lease by specific quantitative standards. The lease should explicitly provide that violation of any environmental standard, as determined by EPA's monitoring program, shall result in shut-down of the operation. Recommencement would be dependent on correction of the circumstance(s) which led to violation.

5. Environmental standards developed in the preliminary lease phase: Specific standards for revegetation and for consumptive water use should be determined in the preliminary lease phase, through the work of the agencies described in 3. above. These standards should be incorporated in the final lease, with provision for shut-down as described in 4. above.

6. Administration of the lease: An interagency coordinator for the leasing program should be appointed by the Council on Environmental Quality from outside the Department of Interior, to be responsible for overall administration of the preliminary and final leases. In addition, an individual should be designated by the Secretary of Interior to exercise line authority over the Mining Supervisor. The Mining Supervisor's authority would in turn be confined to overseeing and monitoring the mining operations.

7. Other research during the preliminary lease phase: During the preliminary lease phase, the interagency Colorado River Basin Commission should extend its framework study to appraise and predict the specific effects of oil shale development, including power generation and transmission, effects on water and water users in the Basin, transportation and urban development. This information should then be used in the environmental analyses of the final lease proposals, as discussed in 1. above.

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